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CONTENTS.

EDITORIALS 1025
F. W. Frueauff 1029
The National Electric Light Association Convention 1030
Florida Mining Company Increases Equipment 1032
North Shore Electric 1032
New Eiffel Tower Wireless Service 1032
New York Electrical Society 1032
Chicago Sanitary District Lighting Scheme 1032
Central Union Telephone Company 1032
Twenty-Eighth Street Line Sale Postponed 1032
Electricity Supply and Transmission in St. Louis 1033
Arkansas Association of Public-Utility Operators 1043
American Society of Mechanical Engineers 1044
Three-Phase Arc Lamp with Four Carbons 1044
Wireless Companies Consolidated 1044
Practical Application of the "Singing Spark" System 1044
Mexican Telegraph 1044
The First Convention of the National Electric Light Association 1045
Twenty-five years of the National Electric Light Association 1051
Southern Power Mortgage 1056
Empire State Gas and Electric Association 1056
Tenders for Canadian Hydroelectric Plant 1056
Northwestern Telegraph Company Sold 1056
Chicago Electric Club 1056
More Side Door Trains in New York 1056
Commission News from New York 1057
Electric Power in the Gold Mines of Johannesburg, South Africa 1057
The International Airbrake Association Holds Convention at Indianapolis 1058
McAdoo Tube Granted Time Extension 1058
Public Service Commissions 1058
Pacific Coast Convention of American Institute of Electrical Engineers 1060
Electric Power in Coal Mining 1064
Anaesthesia by Electric Current 1064
The Evolution of the Switchboard. Twenty Years Progress.—II 1065
Running a Railroad Without Accidents 1066
Lighting for Mexican Cathedral 1067
Underground Electrical Distribution 1068
New Equipments in Electro-Culture 1071
Permanent Technical Exhibition in Milan 1071
Electrical Discharges over Photographic Plates 1072
Chance for Telephone Manufacturers 1073
Electrical Temperature Measurements of Concrete 1073
The Electrolytic Separation of Iron 1074
United Railways Improvement Bond Issue Approved 1074
Influence of the Spark-Gap Metal on the Frequency of Electrical Vibration 1074
Electrolytic Theory of Dyeing 1075
Electrically Operated Cranes 1076
Tests with Paper-Free Mica Tubes 1077
Development of the Electric Sign Business 1077
Electric Station for Kansas City 1077
New Third Avenue Railroad Company Incorporated 1077
FINANCIAL REPORTS OF ELECTRICAL COMPANIES 1078
NEW ELECTRICAL AND MECHANICAL APPARATUS AND APPLIANCES 1079
Chicago Battery Company Announcement 1078
CURRENT ELECTRICAL NEWS 1088
RECORD OF ELECTRICAL PATENTS 1093

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THE DEVELOPMENT OF ELECTRIC LIGHTING.

Electric lighting had its beginning when Sir Humphrey Davy, just a century ago, electrified a London audience by striking an arc between two pieces of charcoal. About the same time, Davy also heated a platinum wire to incandescence by the electric current, and thus blazed the way for the incandescent bulb of today. For years the production of electric light remained a laboratory experiment, and although inventors were developing improvements in the use of gas-retort carbons, of various materials for filament, and of exhausted bulbs, and patents were taken out for feeding the carbons, it was not until the invention of the dynamo that electric lighting began upon a commercial scale.

The arc light of Jablochkoff, brought out in 1876, marked a distinct advance, in that it obviated troublesome and expensive feeding mechanism, and this type of lamp found extensive application, both in America and Europe. Shortly afterward, the Brush series arc-lighting system came into vogue, and local lighting stations were started in many cities. Many improvements were made in the mechanical and electrical details of the lamps, and in the quality of the carbons, and the use of arc-lamps for street lighting spread steadily. Weston's arc lamps and dynamos began to be used in considerable numbers, and about 1881 the Thomson-Houston system made its appearance.

Comparatively little use of the arc for indoor lighting was made until the introduction of the enclosed arc, with its lessened consumption of carbons, longer arc, and voltage better suited to a constant-potential system. The already high radiant efficiency of the arc lamp has been materially improved in the flaming-arc lamp of today, which is peculiarly suited for high-power illumination of outdoor areas, and magnetite lamps are found upon many of our city thoroughfares today. The use of titanium-carbide for electrodes has also resulted in a much lower specific consumption of power, one-quarter of a watt per candle being claimed for this lamp.

The first patent granted in the United States for an incandescent electric lamp was issued in 1858, and was for a platinum filament, but prior to this Starr had used both platinum and carbon in an evacuated bulb. Many inventors had tried other metals for filaments, but it remained for Edison, in 1879, to introduce the first commercially successful incandescent lamp, using carbonized bamboo for the filament.

Edison also experimented with dynamos, producing the first machines with low armature resistance, and some of these early Jumbo machines have remained in use almost to the present day. Edison also developed the idea of multiple operation on constant potential circuits, and by his three-wire system reduced the cost of the necessary copper.

Since that time improvements have been made in methods of lamp manufacture, other sources of carbon have been utilized, the cost of production has been much lessened, yet the Edison lamp of thirty years ago is, in all its essential characteristics, still being manufactured today. But the knell of the carbon filament seems about to be sounded. Improvements in the material brought the specific consumption of the carbon filament down from five to three and one-tenth watts per candle and the metallized filament has still further reduced this to 2.5 watts per candle. But the still better efficiency and the whiter quality of the metallic filaments now in the market seem destined to prove features before which the carbon filament must beat a retreat.

The tantalum lamp brought the specific consumption down to two watts per candle and the tungsten filament has brought it to one and one-quarter watts per candle, and this lamp is moreover available for both alternating-current and direct-current circuits. Much progress has lately been made in overcoming the brittleness of these filaments and the tungsten has even been obtained in a ductile condition. While other metals, such as osmium, titanium, zirconium and iridium, have been investigated, it does not seem likely that any of these will be developed to commercial possibilities. The coating of a carbon core with some substance of high melting-point might be expected to give an efficient and rugged lamp and great things were promised for this type a few years ago. Thus, in the Helion lamp of Parker & Clark a coating of silicon was deposited on the ore, and the filament was worked at a temperature of 2,300 degrees centigrade, giving a specific consumption of only one watt per candle. But nothing has been heard from this commercially.

The use of a non-oxidizable and refractory substance as an incandescent body was early recognized as a desirable feature, but the oxides are in general non-conductors at ordinary temperatures. The discovery that this class of substance became conducting at high temperatures opened a new field of experimentation, and the Nernst lamp was the result. For a dozen years this lamp has been undergoing development, and while the metallic filament lamps have invaded its natural field, it has survived competition and its continuous improvement has made it a factor in the lighting of today. The principle obstacle in its way has been its short life when used with direct current, but this has been overcome to the extent of giving it an average life of 600 hours on direct current, as compared to 800 hours on alternating current.

The mercury vapor lamp originated by Arons in 1892 has been developed principally by Hewitt, and was put into commercial use in 1901. While the color of the light furnished by this lamp has retarded its general introduction, the very high efficiency is a strong point in its favor, and this has been still further increased by Hereaus, who substituted quartz for the glass tube, thus permitting the lamp to be operated at a higher temperature.

The only other form of vacuum-tube lamp to be developed along commercial lines is the Moore Light. Geissler and other forms of vacuum tubes have been familiar objects in the physical laboratory for many years, but it was not until 1896 that Moore introduced this form of light for illuminating purposes. Since high voltages are necessary for such discharges, this system lends itself to adoption only on alternating current systems, the voltage being stepped up at the point of use. The low intrinsic brilliancy and large area of this source render it ideal for many purposes and put it in conformity with the recognized requirements for a theoretically perfect source. The color of the light can be varied by using different gases in the tubes, and the efficiency is of the same order as that of metallic filament lamps.

A century of development has thus brought not only a great increase in the efficiency of electric lighting, but has also witnessed the introduction of a variety of sources of illumination, each peculiarly fitted for its special service. The lamps of today may in the course of another century all become obsolete, but what form their successors may take, no man can tell.

ELECTRIC POWER IN THEATRES.

Recent applications of electricity to power service in certain representative theatres lately completed in America furnish fresh examples of the dependence of the arts of amusement upon the engineer. Take away the details of building construction, the heating, ventilation, fire protection, sanitation, and electrical service from the modern playhouse and there is left an ornamental shell pleasing to the artistic sense, but as unworkable as a machine tool without a driving shaft. Probably not more than one in a thousand of the patrons of the New Theatre at New York or the Boston Opera House gives a single thought to the acuteness with which engineering difficulties have been analyzed in order to promote the comfortable enjoyment of the illusions nightly fared forth upon the stage, but if the work of the engineer is behind the scenes here in a double sense it is still of commanding interest, and this entirely apart from the technical specialty of utilizing natural forces upon the stage itself in connection with scenic portrayals.

Extreme variations in power requirements combined with the ability to mass energy at specific points for particular occasions characterize the theatrical service of the present time. The sectionalizing of the stage to permit various portions singly or together to be raised and lowered by the motor drive; installation of stage-turning equipment enabling

successive scenes to be set with a minimum lapse of time in front of the curtain; operation of organ blowers, ventilation fans, curtains, passenger and freight elevators, special flashers, vacuum cleaners, air compressors, coal and ash hoists, and finally, the driving of dimmers in a multitude of combinations, disclose rapid strides within the past few years toward the freeing of the stage from all needless complications, the assuring of greater reliability at critical moments involving intricate property combinations, and the quickest possible response of equipment to the will of the stage manager and his associates.

The interconnection of the power service with the special tasks of stage lighting enables illumination effects to be secured with a precision hitherto lacking in hand operation of switches and dimmers. Subdivision of footlights and borders into appropriate sections and colors controlled by small motor-driven switch and dimmer shafts with interlocking arrangements, facilitates combinations of light gradation far above the range of practicable hand service, and with noteworthy economies in labor and space. Removal of dimmers and switches from the wings to fireproof compartments below or at the side of the stage minimizes the fire risk, and the introduction of the principles of remote control enables those responsible for the operation of the apparatus to remain in plain view of the stage without sacrificing convenience of manipulation.

The centralization of power distribution illustrated in the most modern theatres includes the massing of switch and fuse panels controlling numerous pockets which furnish outlets for electrical service in the floor of the stage, in the boxes, fly galleries, and auditorium and corridor sections of the house. Separation of lighting circuits to provide for partial control of illumination from the front of the theatre is a necessity recognized by the public statutes. The installation of special lighting and electric heating service in dressing rooms, corridors, parlors and artist's quarters introduces many interesting problems in circuit arrangement, as do the requirements of orchestras situated on movable floors, the need of cutting down energy consumption to a minimum during the daytime and summer-cleaning periods, and the provision of emergency switching connections for the maintenance of continuous service under all anticipated conditions. The construction of the house with numerous floor levels and sloping tiers of seats complicates the wiring design almost beyond belief. Finally, the introduction of numerous auxiliary telephonic and signal services at various voltages and diversified points ties the whole house together as a single organization responsive to the stage manager, and provides for the electrical transmission of orders, time-beating signals, emergency and routine information and instructions with an ease and speed never realized in the playhouses of the previous generation. Such applications tend to eliminate friction, reduce the dangers of fire, keep down manual work to the minimum, shorten the time of preparation for acts, insure better ensemble work among stage employes and persons in the cast, and in general increase the efficiency of the amusement-producing machine as a whole. The specialized nature of such problems illustrates in an interesting way the extent to which the engineer is obliged to master the details of other occupations in order to create successful installations of economical equipment.

THE QUESTION OF RATES.

Probably one of the most difficult problems which the electrical industry has ever had to face is the adjustment of charges to consumers for electric light and power, due to a complexity of conditions which make the classification of costs for charging difficult to adjust. The multifarious character of the demand upon the resources of a corporation supplying electrical energy makes this problem distinctly different from other industrial undertakings, and the uncertainty in the relationship between conjectural and actual demand makes well nigh impossible the establishment of definite principles upon which to base a system which will be conceded equitable on the part of both consumer and corporation.

The recent domination of public-service commissions in a number of states and the arbitrary manner in which well-established precedents have been overthrown, are sufficient to give those responsible to the stockholders of public-utility corporations grave concern over the question of rates and a reasonable return. What we have in many cases deemed a logical procedure in the establishment of capital charges we find does not agree with the ideas of the tribunal which has been set up to safeguard the interest of the people at large, and the nice balance which must be effected in many cases so as to bring our older methods and ideas into conformity with the new dictation must be carefully worked out in order that immediate distress may not be occasioned even though in the long run it is assumed that the greatest good will come to the greatest number.

Ever since corporations settled into the definite business of generating electrical energy for the supplying of the needs of private consumers there have been great efforts made to establish systems of charging which would satisfy the consumer and at the same time render the service profitable to the corporation. Many plans have been suggested, some of these classical in their nature and in the scope of the investigation which has been undertaken to determine the principles upon which they are based. Many companies have established systems which differ entirely from the methods employed in even contiguous territories, but the prevailing system is apparently that based upon the kilowatt-hour rate, modified by discounts for prompt payment, for various classifications of service, and with various initial or minimum charges aimed to cover a conjectural service cost.

Under the system of charging by the kilowatt-hour rate

it has been difficult for the central station clearly to indicate the elements which enter into the making up of the charge, but further than this it has been pointed out recently that this system is unfortunate in that where there is a great and distinct advance in the art of improving the efficiency of the unit which is under the control of the consumer, the central station has no means by which it can forestall a loss to it where it supplies a lessened amount of the commodity for which it is paid a running rate and at the same time increases greatly the expense for delivery of this commodity.

The present situation seems to indicate very clearly this condition. Where the consumer demands the installation of tungsten lamps the cost to the central-station company is just as great as and possibly greater than it ever was before, but the income based upon the running current charge is reduced, and while it is true that the lessened demand on the part of the consumer releases so much more capacity for the supply of new customers, the cost of serving these new customers is out of proportion to the additional revenue produced.

There may be cases where owing to a highly efficient organization, perfect superintendence, and an absolute control of the diversity, central stations may be serving even at a low rate per kilowatt-hour, but with a connected load large enough so that the installation of higher efficiency units does not make heavy inroads upon the revenues. At the same time there must be a limit to the ability of even these to withstand the improvements, so long as these improvements are encroachments upon a revenue-producing element.

There is much of logic in the statement made by S. E. Doane in his recent contribution entitled "The Cost of Light." In his belief there are many small central stations today that are not being paid for the cost of electrical service by small consumers, because this fixed charge does not diminish with decreased consumption or demand. It costs just as much to read a meter of a consumer burning tungstens as it does for the consumer using carbon lamps. The investment in poles, insulation, etc., required per customer is about the same regardless of the size of wire required for his connection, but depends somewhat on the density of service or the number of connections within a given area. The bookkeeping, expense of meter repairs and maintenance costs are no less in one case than in the other.

Public-service commissions do not hesitate to establish rates and in every instance where commissions have been established they are either in control or desire to be in control of capitalization and the profit to be returned upon such capitalization.

It can be readily appreciated by any student of this subject the apprehension with which the industry looks forward to the tearing down of systems which have been built up at the expense of a long education of the customer and the tireless effort of those engaged in seeking to establish a definite basis for charging. But it seems also to be the order of the day that the question must be looked into and it follows that the central-station man must not leave it for legislatures which may be without the definite knowledge which he possesses of all the merits of the case to establish for him rates which may possibly work damage to him in the future.

ELECTRIC PUMPS FOR IRRIGATION.

With the increasing area of cultivated land in our Western states and the growing tendency toward irrigation, the methods of supplying water to semi-arid land are attracting more and more attention. In the beginning there were but two ways that came into universal use, the long aqueduct, and the privately owned windmills. The long aqueduct, being owned by a company which could dictate its own terms, was expensive and inconvenient. The windmill, on the other hand, had to be supplemented with extensive storage tanks or ponds, so that times of calm might be bridged over.

Quite recently the electric motor has come into an extensive use for pumping in regions supplied with a power-transmission line and is being promoted by some of the smaller companies. The favor that a pumping load found in the eyes of one central station is shown by the fact that this plant, located in New Mexico, ordered four hundred horsepower of motors in small units for pumping. The company has guaranteed that some of the largest of its motors will furnish water to the consumer at less than one cent per thousand gallons.

TWENTY-FIFTH ANNIVERSARY OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

The convention of the National Electric Light Association at St. Louis, May 23 to 27, will commemorate the twenty-fifth anniversary of the organization of the Association.

Among the many notable papers which will be presented there will be several devoted to the early days of the organization and to a review of central-station development during the last twenty-five years.

This convention and the exhibition of electrical apparatus and kindred appliances which will be held in conjunction therewith will in all likelihood be one of the most notable gatherings ever held by electrical men.

On many pages of this issue we have published several articles dealing with the first meeting of the Association and with some of the interesting matters which have come before the organization since its inauguration.

The National Electric Light Association is a great institution, and it has been wonderfully well managed. On the threshhold of its twenty-fifth anniversary we extend the hope that the glories of the past may never grow dim and that the future may bring forth only increased brilliancy, and that the work of the Association may long continue for the peace and comfort of everyone who shall have a part in the development of this great industry.

New Searchlights in the Canal Zone.

An item in a recent issue of the *Canal Record* shows something of the increasing use of electricity in the Canal zone and of the ways in which it is facilitating work on the canal.

According to this item, barges loaded with stone and sand are now unloaded at the Gatun docks by means of electric searchlights. There are one single and two duplex cableways for unloading sand and rock, and one searchlight for each cable has been placed on the tail towers, casting light along the cables, on the barges at the dock, and over the storage piles. The searchlights have eighteen-inch standard Navy projectors, and are operated by a motor-generator which changes the 600-volt current supplied from the power plant to a 125-volt current for the lamps. The lights are controlled from the head or operating towers. In addition to the searchlights strings of flaming arc lights have been stretched from the head towers to the tail towers, four lamps for each tower. These lamps form their arc at the apex of an acute angle made by the carbons, and therefore throw a light equally in all directions. On this account, although they are strung below the level of the cables they illuminate them as well as the storage piles beneath.

A Public-Spirited Electric Company.

The Mobile Electric Company, of Mobile, Ala., was one of the first business institutions in that city to respond to a movement recently inaugurated by the *Mobile Register* to form a non-political organization for the purpose of uniting for the industrial development of the city.

Each member of the organization contributed $100 in cash. It is part of the policy of the Mobile Electric Company, which is under the management of H. M. Byllesby & Company, to cooperate to the fullest extent in all meritorious movements for the general good of the community of which they are an important element.

Frank W. Frueauff.

Frank W. Frueauff has done so many things in the comparatively short time he has been among us that it is hard indeed to attempt a sketch that will do him credit. Personally, he is such a quiet, unassuming sort of gentleman that it does not seem possible that so much dynamic can be stored up within him, but there it is, and it has been working full power for quite some time.

Mr. Frueauff was born in Columbia, Pa., on May 29, 1874. He moved to Leadville, Colo., in 1881, and later to Denver, Colo., in 1887. He attended the public school in Denver and graduated in 1891. Entering the service of the Denver Consolidated Electric Company in September, 1891, as lamp clerk and meter reader, he advanced through various positions to that of cashier of the company in 1899. The Denver Consolidated Electric Company and the Denver Consolidated Gas Company were merged shortly after and Mr. Frueauff was made secretary of the united company, the Denver Gas and Electric Company.

FRANK W. FRUEAUFF,
President of the National Electric Light Association.

In 1904 he was made general manager and vice-president of this company. He is a partner of Henry L. Doherty & Company; vice-president and general manager of the Denver Gas and Electric Company; vice-president of the Pueblo (Colo.) Gas and Fuel Company, Lincoln (Neb.) Gas and Electric Light Company, Doherty Operating Company, Lebanon (Pa.) Gas and Fuel Company, the Empire District Electric Company, Joplin, Mo., Spokane (Wash.) Gas and Fuel Company, Montgomery (Ala.) Light and Water Power Company, secretary McCombe Electric Company, Alberta, Canada; treasurer Summit County (Colo.) Power Company; director Massilon (Ohio) Gas and Electric Company.

Mr. Frueauff was made president of the National Commercial Gas Association in 1908, and was elected president of the National Electric Light Association in 1909. He also holds membership in the American Gas Institute, Colorado Light, Power and Railway Association, and belongs to the Lawyers' Club and Engineers' Club of New York, Denver Athletic Club, Denver Country Club, Overland Country Club of Denver, Sons of Jove, and El Jabel Shrine.

Navy Wireless Tests Begin.

The cruiser Birmingham, which has been in Liberian waters for several weeks, has sailed for Hampton Roads via Cape Verde after having been relieved by the auxiliary cruiser Des Moines.

The vessel, which is fitted with a powerful wireless outfit, will endeavor to get in touch at the earliest moment with the new naval wireless station at Brant's Rock, on the Massachusetts coast, to test the maximum sending capacity of the outfit. As the tower at Brant's Rock has a much more powerful transmitting apparatus than the ship, it is expected that the Birmingham will be receiving many messages that she cannot answer while on her way across the South Atlantic.

The National Electric Light Assocation Convention.

Programme by Sessions of the St. Louis Meeting, May 23, 24, 25, 26 and 27.

The full programme by sessions of the annual convention of the National Electric Light Association, to be held at St. Louis, Mo., May 23, 24, 25, 26 and 27, is given below. On Monday, May 23, there will be no regular business session, that day being devoted to the registration of members and guests and to a reception which will be given in the evening.

GENERAL SESSIONS.

Tuesday, 10 *a. m.*—Welcome to St. Louis. (1) President's address. (2) Announcements. (3) Report of editor of Question Box, John C. Parker. (4) Report of editors on Question Box revision, Paul Lüpke and Alex. J. Campbell. (5) Report of committee on progress, T. C. Martin. (6) Paper, "Super-Specialization," Paul Lüpke. (7) Report of committee on membership, H. H. Scott. (8) Report of official representative on the National Conservation Commission, Dudley Farrand.

Tuesday, 2:30 *p. m.*—(1) Report of lamp committee, W. F. Wells. (2) Paper, "Periodic Lamp Renewals," by A. G. Strickrott. (3) "Magnetite and Flaming Arc vs. Open and Inclosed Carbon Arcs for Street Illumination," by W. D'A. Ryan. (4) "New Form of Tungsten Lamp," by C. F. Scott. (5) "High-Efficiency Lamp," by S. E. Doane.

Wednesday, 8 *p. m.*—Anniversary meeting. (1) Paper, "Founding the Association," by E. A. Sperry. (2) Address, "Twenty-five Years of Central-Station Commercial Development," by Samuel Insull. (3) Report of public policy committee, by W. W. Freeman. (4) Election of nominating committee. (5) Report of secretary and treasurer.

Friday, 10 *a. m.*—(1) Report of committee on preservative treatment of poles and cross-arms, by W. K. Vanderpoel. (2) Report of committee on terminology, by W. H. Gardiner, Jr. (3) Report of insurance expert, by W. H. Blood, Jr. (4) Paper, "Decentralized Steam Plants," by R. D. DeWolf. (5) Memorials, by T. C. Martin. (6) Report of nominating committee. (7) Election of officers.

TECHNICAL SESSIONS.

Wednesday, 10 *a. m.*—(1) Report of overhead-line-construction committee, by Farley Osgood. (2) Paper, "Location of Faults in Underground Cables," by W. A. Durgin. (3) Paper, "A New Departure in Distribution Construction Methods," by S. B. Way. (4) Report on the grounding of secondaries, by W. H. Blood, Jr. (5) Paper, "Use of the Oscillograph in Fuse Testing," by Alex. Maxwell.

Wednesday, 2:30 *p. m.*—(1) Report of meter committee, by G. A. Sawin. (2) Paper, "Space Economy of Turbo-Generators," by Paul H. Lincoln. (3) Paper, "Direct-Current Turbo-Generators," by W. L. Waters. (4) Report of gas-engine committee, by I. E. Moultrop. (5) Paper. "Gas-Engine Plant for Central Stations," by Nesbit Latta. (6) Paper, "Interesting Points About Modern Transformers," by E. G. Reed, Pittsburg.

Thursday, 10 *a. m.*—*Transmission Session.*—(1) Paper, "Present Problems in Energy Transmission," by H. W. Buck. (2) Address on "The Public and the Water-Powers," by Henry L. Doherty. (3) Paper, "Phenomena of Transmission at Highest Voltages," by Dr. C. P. Steinmetz. (4) Paper, "Modern Transformers for Transmission Work," by K. C. Randall. (5) General discussion on organization and work of the Transmission Section.

Thursday, 2:30 *p. m.*—(1) Report of committee on protection from lightning and other static disturbances, by B. E. Morrow. (2) Paper, "Comparison of American and European Switchboard Practice," by Stephen Q. Hayes. (3) Paper, "Voltage Control of Generators and Feeder Systems," by F. W. Shackelford. (4) Paper, "Feeder Regulators," by E. E. Lehr. (5) Paper, "Water Intake from the Mississippi River for Two Electric Generating Stations in St. Louis," by John Hunter. (6) Paper, "Precautions When Using Instrument Transformers," by L. T. Robinson.

COMMERCIAL SESSIONS.

Wednesday, 10 *a. m.*—(1) Paper, "Latitude of Commercialism," by Arthur S. Huey. (2) Paper. "Residence Lighting," by H. J. Gille.

Wednesday, 2:30 *p. m.*—(1) Paper, "Advertising," by H. K. Mohr and C. W. Lee. (2) Paper, "Automobiles," by Hayden Eames. (3) Paper, "Ornamental Street Lighting," by E. L. Elliott.

Thursday, 10 *a. m.*—(1) Paper, "Sales Department Organization," by T. I. Jones. (2) Paper, "A Plan to Interest National Advertisers in Electric Publicity," by Frank B. Rae, Jr. (3) Paper, "Industrial Lighting with Incandescent Lamps," by S. H. Hall, J. M. Hoit and Paul Bauder. (4) Paper, "Prompt Execution of Orders," by C. N. Stannard. (5) Paper, "Electricity on the Farm," by Herman Russell.

ACCOUNTING SESSIONS.

Wednesday, 10 *a. m.*—(1) Report of committee on uniform accounting, by John L. Bailey. (2) Paper, "Accounting Methods as Applied to Detroit Properties," by E. J. Bowers. (3) Paper, "Care and Handling of Customers' Accounts," by J. M. Mulvihill. (4) Paper, "Storeroom Accounting," by R. F. Pack.

Wednesday, 2:30 *p. m.*—(1) Paper, "Significance of Statistics," by George A. McKana and B. F. Maguire. (2) Paper, "Classification of Income and Sales," by W. W. Dow. (3) Paper, "Job or Work Order System," by R. D. Rubright.

THE NEW TRANSMISSION SECTION.

A feature of the St. Louis meeting will be the new Transmission Section, the chairman of which is David B. Rushmore, engineer in the Power and Mining Department, General Electric Company, Schenectady, N. Y. This section will comprise an organization of operating companies with which will be associated manufacturers of apparatus used in electrical transmission work, consulting engineers, and others interested in electrical transmission. One of the first things to be done by the new section will probably be the standardization of transmission engineering practice which work is expected to be supplementary to that of the American Institute of Electrical Engineers along this line.

TRANSPORTATION.

A special convention train will be run to St. Louis to convey the New York, New Jersey and New England delegates. This train will leave New York city by way of the New York Central on Sunday, May 22, at 2:45 p. m. and will arrive in St. Louis at 2 p. m. on Monday. This train will be first-class in every particular, carrying ob-

servation, buffet and dining cars, and will pick up the Schenectady, Rochester and Buffalo delegations en route. The New England delegation will leave the South Terminal, Boston, on Sunday, in special cars attached to the 11:30 a. m. train by way of the Boston & Albany Division of the New York Central Lines, due at Albany at 5:25 p. m., where connections will be made with the special convention train from New York city.

The Pennsylvania Railroad Company has also arranged for a special convention train which will leave Jersey City at 11:14 a. m. on Sunday; Philadelphia, 1:10 p. m.; Pittsburg, 9:45 p. m.; Indianapolis, 7 a. m., and arrive in St. Louis at 1:25 p. m. on Monday.

Arrangements have been made with the Chicago & Alton Railroad for a special train leaving the Union Station, Chicago, Monday, May 23, at 10 a. m., reaching St. Louis at 4:30 p. m. the afternoon of the same day. The Wabash Railroad Company, H. L. Purdy, passenger agent, and the Chicago & Estern Illinois Railroad Company, A. B. Schmidt, general agent, passenger department, are also arranging to give careful attention to needs of association delegates.

THE EXHIBITION.

All of the exhibition space at the Coliseum has been sold, and the exhibition promises to be the most successful as well as the most beautiful held in the history of the association.

The following list of exhibitors has been announced:

6 Star Electrical Concern, W. H. Gardiner, treasurer.
34-5-6 Wagner Electric Manufacturing Company, Ray D. Lillibridge.
2-3 Simplex Electric Heating Company, James I. Ayer, manager
9 Pittsburg Transformer Company H. G. Steele.
76-7-8 Allis-Chalmers Company, E. T Pardee, manager.
38-39 Century Electric Company, E. J. Russell, secretary.
8 Federal Electric Company, J. M. Gilchrist, general manager.
23-4-5 General Electric Company, F. H. Gale.
5 The Ricker Manufacturing Company, Geo. Hearn, president.
69 Columbia Meter Company, S. E. Teat, secretary.
40 Philadelphia Electric and Manufacturing Company, C. S. Bundy, secretary.
91-92 Central Station Development Company, W. H. Wissing, vice-president.
31 The Tungstolier Company, E. J. Kulas, president.
80 Fort Wayne Electric Works, F. S. Hunting, sales manager.
90 Duncan Electric Manufacturing Company, Thos. Duncan, managing director.
10 Minerallac Electric Company, L. A. Ferguson.
11 G & W Electric Specialty Company, P. F. Williams, president.
52 Popular Electricity, J. C. Kauffman, auditor.
12-13-14 Westinghouse Companies, J. C. McQuiston.
17-18-19 National Electric Lamp Association, S. E. Doane, chief engineer.
4 Sangamo Electric Company, R. C. Lanphier, secretary.
7 American Electric Heater Company, Robert Kuhn, secretary.
57 Standard Underground Cable Company, P. W. Smith, vice-president.
29-30 W. N. Matthews & Brother, Claude L. Matthews.
79 Electrical Review and Western Electrician, H. S. Tuthill, secretary.
66-67-68 H. W. Johns-Manville Company, J. W. Perry, manager.
28 Hart Manufacturing Company, G. E. Palmer.
21 Monolithic Conduit Company, S. B. Way, president.
84 W. J. Jeandron.
83 Fibre Conduit Company.
1 Diamond Rubber Company.
2 Metropolitan Engineering Company, W. M. Mann.
41-42-43 Moloney Electric Company, T. O. Moloney, president.
70-71 Electric Storage Battery Company, Chas. Blizard, third vice-president.
32 The Waverley Company, W. C. Johnson, secretary.
63-64 Western Electric Company, F. X. Cleary, advertising manager.
37 Electrical World, J. M. Wakeman, first vice-president.
49 Dearborn Drug and Chemical Company.
33 Frank Adam Electric Company, F. B. Adam.
82 Dossert & Company, H. B. Logan, president.
26-27 General Vehicle Company, C. W. Squires, Jr., assistant to the president.
44-45 Wesco Supply Company, C. A. Hobson, manager apparatus department.
62 D. & W. Fuse Company, W. S. Sisson, secretary.
56 Electrical Record, John Prior, office manager.

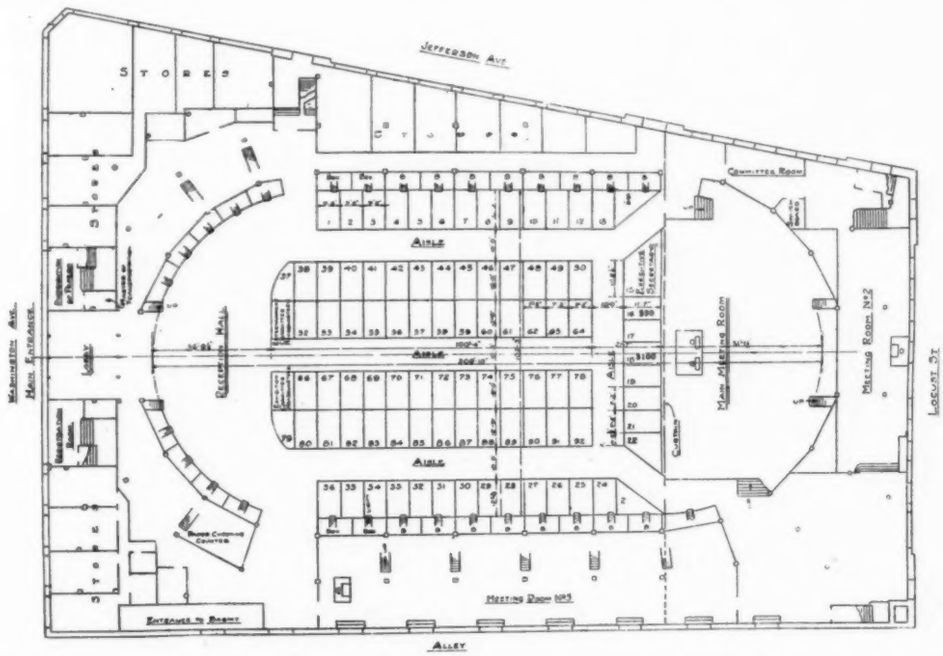


DIAGRAM OF EXHIBITION FLOOR, NATIONAL ELECTRIC LIGHT CONVENTION, COLISEUM, ST. LOUIS, JUNE 21 to 27.

50 Crocker-Wheeler Company, Rodman Gilder, secretary.
55 Benjamin Electric Manufacturing Company, W. D. Steele, vice-president.
72 Columbus Buggy Company, J. A. Weston.
85-86-87 Studebaker Bros. & Company, J. M. Hill.
20 U. S. Light and Heating Company, A. H. Ackerman.
73 Auto Maintenance and Manufacturing Company, G. A. Freeman.
74-75 Rauch & Lang Carriage Company.
60 General Compressed Air and Vacuum Machine Company.
89 Gudeman & Company, Leo Gudeman.
58-59 Baker Motor Vehicle Company, O. B. Henderson, sales manager.
53 Warner Arc Lamp Company, W. F. Warner, secretary.
61 Hubbard & Company.
81 Edison Storage Battery Company.
88 American Z Electric Lamp Company, M. D. Kitt, manager.
54 The H. B. Camp Company, R. P. Keasbey.
48 American District Steam Company, Robert Hall, treasurer.
47 Otis Elevator Company.
61½ Electric Service Supplies Company.
46 G. C. Anderson.
47½ Hurley Machine Company.
89½ St. Louis Electric Heating Company.
75½ Anderson Carriage Company.

Florida Mining Company Increases Equipment.

With the large increase in its phosphate business the Florida Mining Company has found it necessary to extend its power equipment and has recently placed an order with the Allis-Chalmers Company, Milwaukee, Wis., for a 500-kilowatt-ampere, 2,300-volt, three-phase, sixty-cycle, 3,600-revolutions-per-minute turbo-alternator. A new type "C" condenser will be supplied by the same company for maintaining the vacuum. The turbine is practically a duplicate of the one supplied by the Allis-Chalmers Company about a year ago.

North Shore Electric.

The Illinois Lakes Light and Power Company has conveyed to the North Shore Electric Company, of Chicago, all its property, real, personal and mixed, except the telephone system and contracts and ordinances in Crystal Lake and North Crystal Lake and in McHenry County.

New Eiffel Tower Wireless Service.

The new wireless telegraphic service between the Eiffel Tower and ships at sea will be begun at midnight on May 23.

New York Electrical Society.

At the May 11 meeting of the New York Electrical Society held in the Engineering Societies Building, New York city, T. Thorne Baker, of London, Eng., lectured on "The Transmission of Photographs, Wireless and by Wire."

Mr. Baker described the result of recent experimental work in the transmission of photographs over long-distance telephone lines and over short distances by means of wireless. The telephone system has been in use between London and Manchester for the past twelve months, and preparations are now being made for wireless transmission between Hunstanton and Skegness in England, a distance of about sixteen miles.

Mr. Baker, who was the first to operate the alternating system of Professor Korn, described the pioneer experiments between London, Paris and Berlin. Mr. Baker is now in this country for the purpose of establishing phototelegraphic communication between New York, Boston and Chicago. He showed a new portable apparatus for phototelegraphy, which was exhibited for the first time in a lecture he gave just before leaving England last month, at the Royal Institution of Great Britain. The lecture was illustrated by lantern slides and special apparatus.

In connection with this it is interesting to record that on Saturday last, May 14, the first practical demonstration of T. Thorne Baker's "telectograph," when photographs were transmitted wirelessly from the Boston *American's* office to the office of the New York *American*. The tests were eminently successful.

The following new members were admitted at the May 11 meeting of the New York Electrical Society: J. H. Behnken, Dr. W. P. Dun Lang, H. H. Hilborn, Robert Johnstone, Harry W. Nordell, R. H. Ruth, Jacob T. Silver, Lewis B. Stillwell, Thomas Benham Snow, Victor Werner.

The following nominations for officers for 1910-1911 were submitted:

For president, Robert T. Lozier.

For vice-president, H. L. Doherty, Archer M. Huntington, Ernst Woltmann.

For secretary, George H. Guy.

For treasurer, H. A. Sinclair.

Chicago Sanitary District Lighting Scheme.

Another conference to discuss the proposition of the Sanitary District to furnish power to Chicago for street-lighting purposes was held between Sanitary District trustees and city representatives in the rooms of the finance committee last Saturday, May 14.

A number of points not reached at the meeting on the previous Wednesday were first considered. One of these is the question of metering power supplied by the Sanitary District for the operation of the present number of arc lights and 10,000 additional ones at $15 a horsepower-year. In the proposition submitted to the trustees by the city's representatives it was suggested that the power be metered at the primary side of the city's substation transformer.

Other points discussed were the taking over and operation by the Sanitary District of all transmission lines and substations owned by the city; guaranteeing by the Sanitary District of ninety-nine per cent continuous delivery of electrical energy to the city street-lighting circuit, the Sanitary District to furnish the use of its own transmission lines and substations for the conveying of the additional light, free of any charge to the city.

Central Union Telephone Company.

American Telephone plans for the reorganization of the Central Union Telephone Company are making considerable headway. The parent company is arranging for the release of Central Union stock and bonds deposited as collateral behind its own issue of $53,000,000 four per cent collateral trust bonds. Reorganization of the Central Union company will take the form of the incorporation of a new company in Ohio. Another company will be organized to operate Indiana, while the Central Union company itself is to continue in the state of Illinois, outside of Chicago.

Twenty-Eighth Street Line Sale Postponed.

The foreclosure sale of the Twenty-eighth and Twenty-ninth Street Crosstown Railroad Company, New York city, has been again postponed until May 25, at the request of the bondholders' reorganization committee.

Electricity Supply and Transmission in St. Louis.

An Illustrated Description of the Comprehensive System of the Union Electric Light and Power Company.

The city of St. Louis is supplied with electric service by the Union Electric Light and Power Company, a company incorporated under the laws of the state of Missouri, with an authorized capital stock of $18,000,000. The company maintains two main generating stations and seven substations, and has connected to its lines 766,200 incandescent lamps, 7,000 arc lamps, 4,500 Nernst lamps, and approximately 34,875 horsepower in motors. This service is furnished through 24,937 meters and 23,805 connections, 14,000 of which are for residences. During the year 1909 the company delivered from its generating stations 113,335,675 kilowatt-hours, and the output for the month of January, 1910, was 12,160,788 kilowatt-hours.

The Union Electric Light and Power Company also furnishes about 150,000 kilowatt-hours per month to the King Electric Company and the Suburban Electric Light and Power Company, two companies serving the suburbs in St. Louis County, and also furnishes current to several rotary-converter substations of the United Railways Company, of St. Louis.

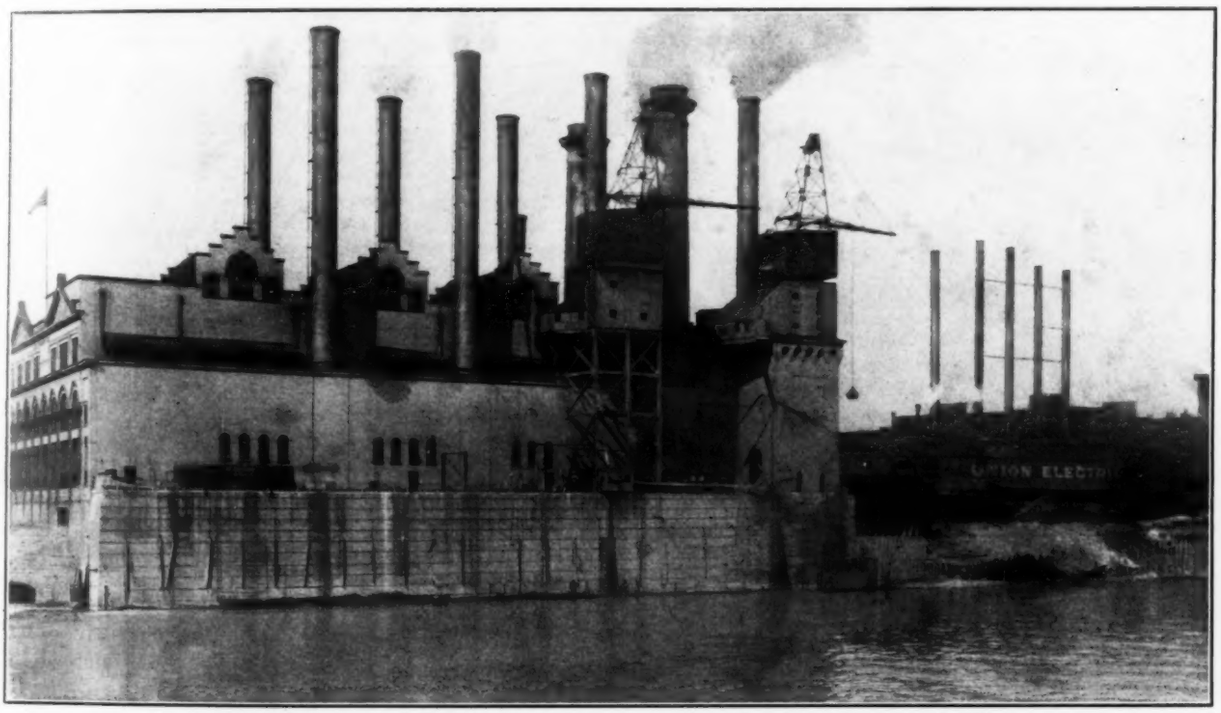
ASHLEY STREET STATION.

The general rule for the location for a central station, namely, that it should be located as nearly as possible at the center of gravity of the system, is often modified by the cost of land, availability of water supply, coaling facilities and various other local considerations. The Ashley Street station, the main central power station of the Union Electric Light and Power Company, is admirably situated to satisfy all these requirements. This station is located on the bank of the Mississippi River, between Biddle Street and Ashley Street. The west side of the station faces Main Street and the east wall of the building is adjacent to the river harbor line. The station is in full sight looking north from Eads Bridge.

The building structure is of steel, the outer walls of grey brick, ornamented with terra-cotta coping. It is 320 feet long, 176 feet wide, eighty-six feet to the top of the roof, and has a floor space of 46,320 square feet. The foundations are entirely of concrete and rest on bed rock; the windows are constructed of metal frames and sashes are fitted with wire glass. The floors and roof are of reinforced concrete, the structure being entirely fireproof throughout. The inside walls of the engine room are finished in white and brown enameled brick.

GENERAL LAYOUT.

The operating room, which occupies the western half of the building with its longest dimension parallel to Main Street, contains eleven main generating units, comprising five engine-driven generators and six turbo-generators. At the south end of the building are the electrical galleries and mezzanines. The exciter sets and motor-generators for supplying the station light and power are located on the main floor. Below the operating floor are located the condensers, pumps and various auxiliaries and piping. In the boiler house, which constitutes the eastern half of the station, there are two floors of boilers, thirty-four on the lower



MAIN STATION OF THE UNION ELECTRIC LIGHT AND POWER COMPANY, ST. LOUIS, MO.

and thirty-four on the upper. In the boiler house basement are the ash car tracks. The coal and ash bunkers and auxiliary machinery occupy the top of the boiler house.

COAL SUPPLY.

In St. Louis at the present time in supplying electric service it is necessary to at first consider the supply of coal. The Union Electric Light and Power Company purchases and consumes 360,000 tons of coal per year, this being equivalent to 10,000 carloads. The coal used is from the Illinois fields in the vicinity of St. Louis, and is received in railway cars. The station is so situated, however, that coal can also be received by river in barges, and large quantities are received in this manner during the summer.

In the yard at the north end of the station is track room for forty cars, and there is a small switching engine for handling the loaded and empty cars. The loaded cars must be hauled up an incline to bring them to a point accessible to the coal-hoisting bucket, and this is accomplished by means of a "dummy car" or "goat," which is operated by wire cables and pushes the railway car before it. To bring a loaded car into position to be handled by this dummy, the latter is drawn into a pit between the rails, and the loaded car placed at a point where the dummy will connect with it when it is drawn from the pit.

Coal is hoisted from the cars by means of a clam-shell bucket operated from a tower at the top of the building, which bucket has a capacity of one and one-quarter tons and can make three trips in one minute. The coal is discharged from the hoisting bucket into small railway cars, which distribute it to the large overhead bunkers. The bunkers are immediately above the boilers and have a capacity of 12,000 tons. The coal is fed by gravity into the furnaces.

Ashes are discharged from the grates to hoppers beneath the boilers. They are collected from these hoppers in small cars which are drawn to electric elevators, where they are hoisted to the top of the building and discharged into ash bins directly under the coal tower. From these bins the ashes are loaded by gravity into empty coal cars.

BOILER ROOM.

In the steam generating part of the station there are sixty-eight boilers, sixteen of which are of the internally-fired marine type, and fifty-two of the water-tube type, having a total normal rating of 38,000 boiler horsepower. There are two decks of boilers, each arranged in two rows of seventeen boilers each, the front of the boilers facing the center of the boiler room.

The marine type internally-fired boilers occupy the lower deck. The water-tube boilers occupy the upper deck of the boiler house. Each boiler occupies a floor space 19.5 by 12.5, has 259 tubes, and a heating surface 5,250 square feet. These boilers are equipped with traveling chain-grate stokers, having 105 square feet of grate surface. The furnaces are of the extended Dutch oven type. Natural draft only is used for these boilers, there being eight self-supporting steel stacks, each of which is ten feet in diameter and 197 feet high. The boilers are connected in groups for each stack. Each boiler has its own superheater. Steam is generated at eighty-four pounds pressure and superheated seventy degrees.

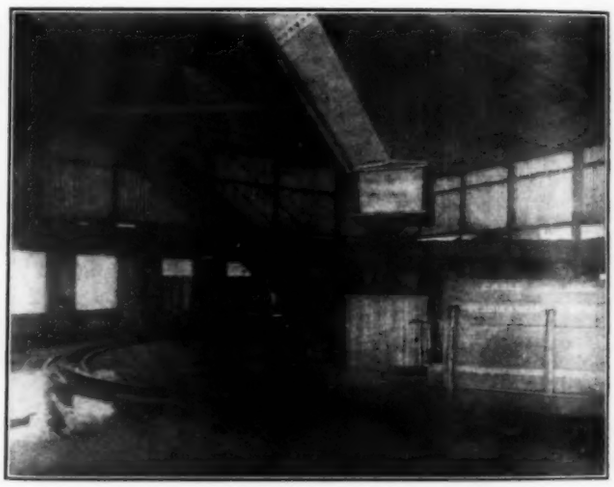
WATER SUPPLY AND FEED-WATER SYSTEM.

To the east of the building and connected thereto is a sea wall running throughout its entire length. The wall is made up of concrete, reinforced with steel angles which are braced to the wall of the building, and the whole of its footing rests on solid rock. The space thus made available between the wall and the building is divided into nine large basins, which are used as settling basins in purifying river water for use in the boilers. A very complete purifying process has been installed in the plant of the Union company and the results obtained are very satisfactory. The raw river water passes through the water-softening plant where it is treated with lime, iron and soda, and is then discharged into the settling basin where the purifying process is completed, the basins operating in series.

The capacity of this system is 150,000 cubic feet of water per day. The company maintains a chemical laboratory where the water is analyzed twice each day, and the results show that water analyzed after passing through this system is found to be absolutely clear and of very little hardness.

In the boiler feed-water system the water is discharged from the hot wells, by centrifugal pumps, to four open feed-water heaters. From each

COAL CAR IN POSITION TO BE UNLOADED.

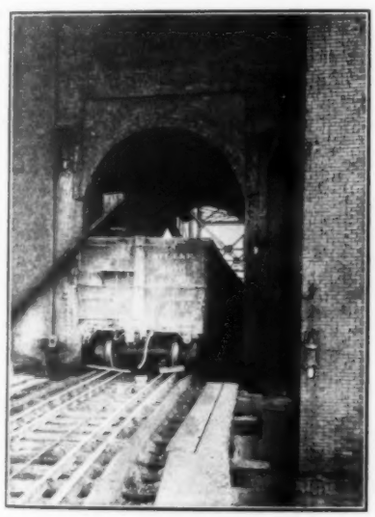


CARS FOR DISTRIBUTING COAL IN BUNKERS.

heater the water flows by gravity to the boiler-feed pumps. There are three boiler-feed pumps installed in this plant and all are of the horizontal, duplex type. Two of the pumps are twenty-four by fourteen by twenty-four inches in size, and have a capacity of 1,200 gallons per minute each. The third pump is of a compound type, and is said to be the largest boiler-feed pump installed in a central-station plant. It is eighteen by thirty-four by seventeen by twenty-four inches in size, and has a capacity of 1,800 gallons per minute. Each pump is equipped with a pressure-controlling valve and there is an automatic feed-water regulator in connection with each boiler.

CONDENSING APPARATUS AND PUMPS.

A feature of the plant arrangement in the Ashley Street station is the unit



LOADING ASHES INTO CAR.

system followed throughout the engine room. Each of the main generating units has its own condenser and air pump, and the engines are so arranged in pairs that the condensing outfit of one is cross-connected to the condensing outfit of the neighboring engine, and either engine can be run with either condenser. The condensing apparatus for each engine consists of a steam-driven wet vacuum pump of the vertical fly-wheel type, and a surface condenser. The condensing equipment for each of the larger turbines is made up of a surface condenser of 20,000 feet tube surface, a twelve by twenty-four by eighteen-inch horizontal steam-driven, dry vacuum pump, and a motor-driven, four-inch centrifugal pump for discharging the condensed steam from the turbine into the well. The turbines are arranged in the unit system the same as the engines, with the exception that the condensing outfit of each turbine is independent and not cross-connected in any way. Five steam-driven centrifugal pumps supply the condensing water for the plant. Two of these pumps have forty-five-inch outlets and a rated capacity each of 70,000,000 gallons of water in twenty-four hours against a total head of forty feet when running at 100 revolutions per minute. These two pumps alone are sufficiently large for supplying condensing water for the entire plant when running at full capacity. Each pump is driven by a eighteen by thirty-eight by forty-two-inch compound Corliss engine.

The pumps receive their water through conduits leading from two intake wells on the river side of the building. The intake wells are in the sea wall at the north end of the building, and each well has two gates opening into it. The outside of the gates are covered with heavy iron bars to keep any large material from getting into the wells, and on the inside of the gates are screens for catching the smaller particles of refuse in the water. These screens are so arranged that they may be raised to the surface for cleaning.

GENERATING EQUIPMENT.

The present total generating capacity of the Ashley Street station is 43,000 kilowatts. There are eleven main generating units installed, five engine driven and six turbine driven. The engine-driven units comprise two 1,500-kilowatt and three 3,000-kilowatt generators, and the turbine driven units comprise two 2,000-kilowatt, three 5,000-kilowatt and one 12,000-kilowatt generators. Ten of the units are three-phase, twenty-five cycle, alternating-current generators, operating at 6,600 volts, and one a three-phase, sixty-cycle, 4,000-2,300-volt alternating-current generator. The 12,000-kilowatt machine has recently been installed to replace one of the older 5,000-kilowatt units, and contracts have already been closed for replacing another of the 5,000-kilowatt units with one of the larger size. Throughout its entire installation the Union Electric Light and Power Company has provided adequate means for the enlargement and extension of all of its properties.

The engines are of the Corliss vertical, cross-compound, direct-connected type. They occupy the main floor space of the engine room and are arranged in a line with their shafts running parallel. All of the engines are supported on solid concrete foundations. The larger engines have a floor space of twenty-eight feet by forty-six feet, stand thirty-seven and one-half feet above the engine-room floor and weigh approximately 600 tons each.

As may be seen from accompanying illustration the four large turbines are located in a line in the north end of the engine room, and the two smaller ones are at the south end adjacent to the engines. The two 2,000-kilowatt turbines are four-stage machines operating at 750 revolutions per minute, and generate twenty-five-cycle current. Two of the 5,000-kilowatt turbines are four-stage machines, gen-

AUTOMATIC COAL FEED.

erating twenty-five-cycle current, and one is a five-stage machine generating sixty-cycle current, all running at 500 revolutions per minute. The 12,000-kilowatt unit is a five-stage machine running at 750 revolutions per minute.

The base of the 2,000-kilowatt units set on a line with the engine-room floor and are supported by five small steel columns. The condensers are suspended from the engine-room floor and are connected to the base of the turbines by large cast-iron elbows. The air pumps set directly beneath the turbines on the engine-room basement floor. The larger turbines set on a hollow cylindrical foundaiton, having the same outside dimensions as the turbine base. The foundation being hol-

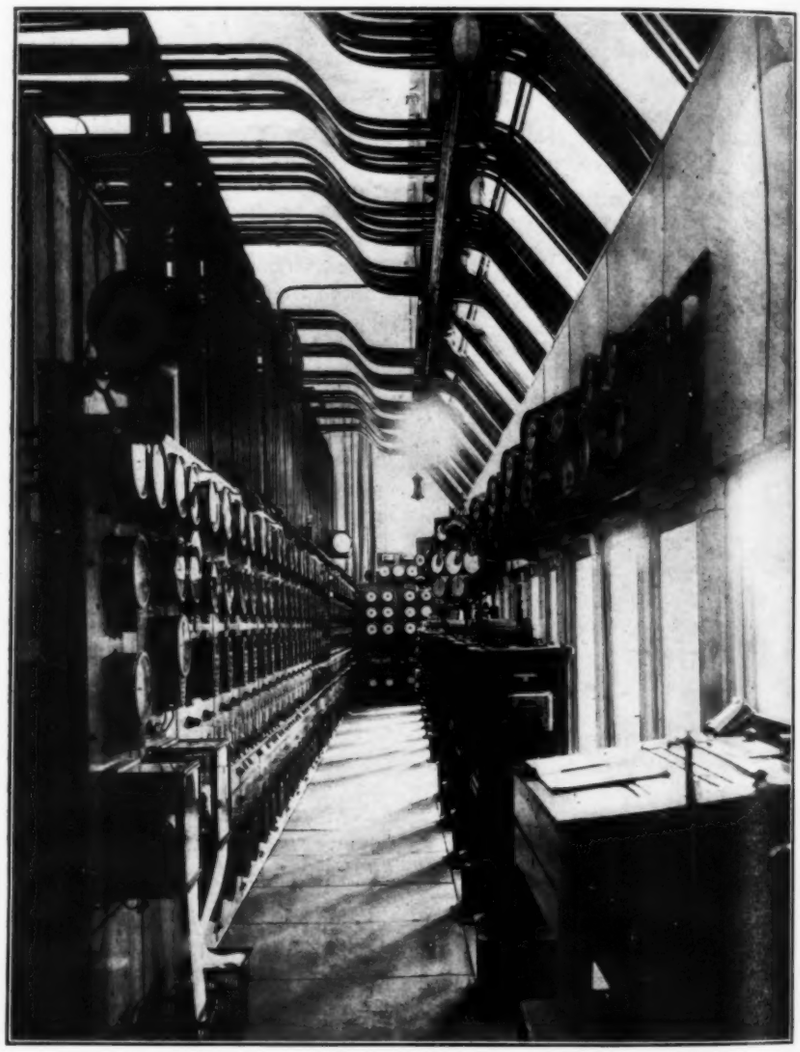
low, the step bearings are readily accessible. Oil is used on the step and guide bearings, and the steam-controlling valves are of the hydraulically-operated type. Each turbine receives its steam through a fourteen-inch steam pipe.

SWITCHBOARD.

The switchboard in this plant is a modern fireproof structure of grey brick and alberene stone, built on five different floors, and it occupies the entire south end of the engine room. Located on the first floor from the top are all of the generator oil switches, generator auxiliary busbars, generator instrument panels, high-tension feeder control board and instruments. On the second floor are the main busses, generator disconnecting switches, and ground detectors. On the third floor are the generator motor-driven field rheostats, feeder selector disconnecting switches, non-automatic oil switches, and current transformers for the instruments located on the first floor. On the fourth floor, or engine-room floor level, are located the automatic oil switches, potential transformers for feeder instruments, current transformers for overload relays, and the switchboard for the controlling of auxiliary apparatus. On the fifth, or mezzanine floor, are the high-tension busbars, step-down transformers for auxiliary apparatus, and on this floor also the three-conductor lead-covered feeder cables, exciter cables and battery leads are supported.

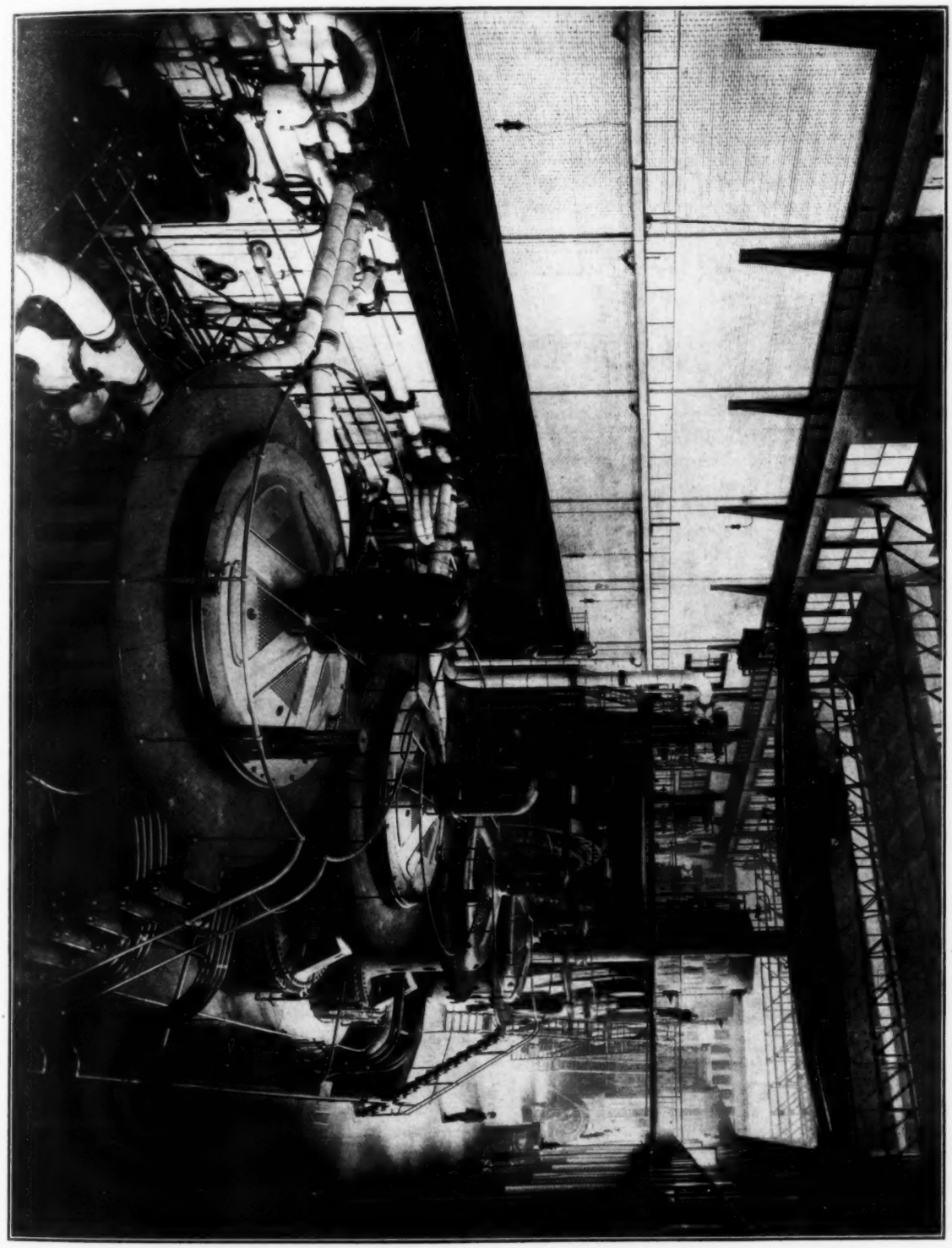
The generator leads pass through the engine foundation and through columns supporting the switchboard to the top of the second floor, where they terminate in potheads, and are carried to the generator oil switches. Each generator is equipped with three oil switches, one main switch and two selector switches. The selector switches are electrically interlocked and are conected to the main busbars through hook-disconnecting switches. All of the governing apparatus, such as oil switches, field switches and field rheostats, are controlled from batteries from the top gallery. The instrument wiring for all feeders and generators is installed in iron pipes and brought above the top gallery, then down to the pedestals, and are thus easily accessible.

The high-tension feeders are connected to the sections of the main bus through two oil switches and a set of disconnecting switches, all in series. The current passes through a non-automatic oil switch to the automatic oil switch equipped with overload relay to the lower floor, where they connect to three-conductor high-tension cables. These cables are surrounded by a concrete cover, which makes them entirely fireproof. All the transmission cables are carried in underground conduits to the various substations, where they terminate. On entering the substations the cables terminate in a hook switch. From this each cable goes to an automatic oil switch equipped with overload and reversed-current relays, thence through another set of hook-disconnecting switches to the bus. The busses in the substations are themselves sectionalized by means of non-automatic oil switches with hook-disconecting switches in series to each section of the bus. From the busses in the substation the current passes through hook-disconnecting switches to an automatic oil switch equipped with overload relays, thence to the 6,600-volt motor driving the direct-current generators, or frequency changes, as the case may be. On the direct-current end of the substation the usual practice has been carried out of equipping generators with switches to enable them to be thrown on either a high or low-voltage bus with the necessary arrangements for a third also, if necessary. A number of the twenty-five-cycle, 6,600-volt feeders supplying the frequency changers at the substation are arranged, by means of selector switches, so that they can be utilized in case of necessity to transmit sixty-cycle energy from the generator stations and substations. In the fre-



SWITCHBOARD IN MAIN GENERATING STATION.

quency-changing stations two generator busses are provided, each bus being arranged to be sectionalized.



ENGINE ROOM IN MAIN STATION OF THE EDISON ELECTRIC LIGHT AND POWER COMPANY.

SUBSTATIONS.

The output from the central station is fed to the distributing system through seven substations, aggregating in transforming apparatus at present installed 22,400 kilowatts, together with storage battery capacity of 2,500 kilowatts for one hour. Of the 22,400 kilowatts in transforming apparatus, 14,000 kilowatts are used in supplying current to the Edison mains; 3,200 kilowatts for supplying current to the 500-volt two-wire power systems; 4,000 kilowatts in frequency changers for supplying sixty-cycle, three-phase, 2,300-4,000-volt service from the twenty-five-cycle, 6,600-volt system; and 1,200 kilowatts in direct-current series arc apparatus, both motor-generators and constant-current transformers with mercury arc rectifiers, from which

direct-current series street lighting is furnished. Provision has been made in all substations for adding additional capacity in substation apparatus as conditions may require. From these substations electric energy is delivered over approximately 355 miles of underground cable, and 3,053 miles of copper wire on 37,000 poles.

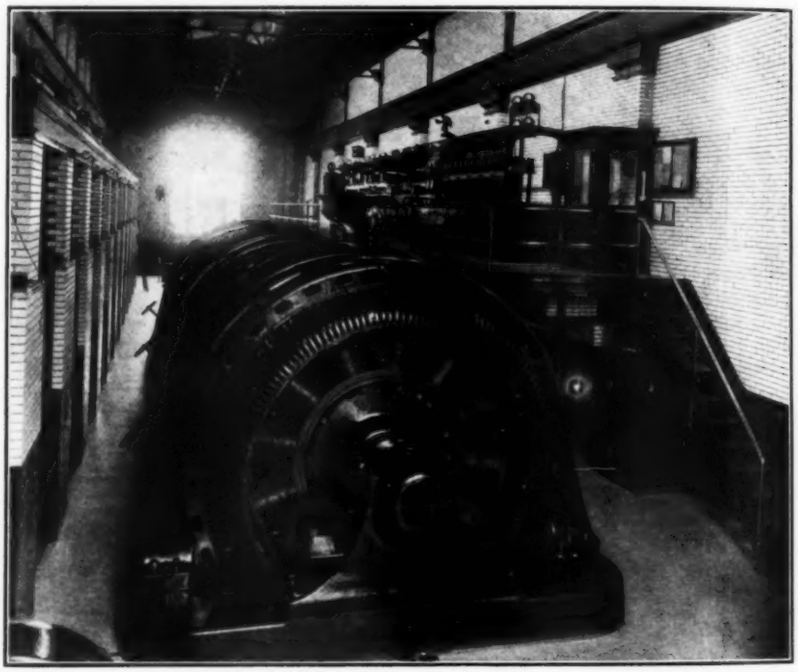
Substation known as No. 1 is located at 707 North Fourth Street and supplies 115-230-volt direct current to the Edison network in the underground district in which it is situated. The building is a modern one-story structure of buff brick, the interior walls are lined with white enameled brick and the floor is of tile.

The equipment of this substation comprises three 1,050-kilowatt National motor-generator sets, which consist of 6,600-volt, twenty-five-cycle, three-phase motors driving 230-volt direct-current generators. An equalizer set consisting of two 100-kilowatt, 115-volt National machines is arranged to automatically compensate for unbalancing in the three-wire system. A three-unit Western Electric booster set is also provided, having a capacity for raising by sixty volts the pressure on each side of a three-wire system carrying 1,350 amperes in the outside wires. Along the left wall, as seen on entering, is arranged the high-tension switches mounted in separate brick compartments. At the right is the switchboard gallery. In the substation basement there is a storage battery of 170 Chloride Accumulator cells, having a maximum discharge rate of 3,456 amperes for one hour. The battery is controlled by four thirty-contact end-cell switches.

Three three-conductor, 6,600-volt, twenty-five-cycle feeders enter this station underground, and after passing the first hook-disconenecting switches are led through motor-operated General Electric circuit-breakers equipped with reverse current relays. They are then led through a second set of hook switches to high-tension busbars. The busses are sectionalized by non-automatic, remote-controlled, oil circuit-breakers. From the 6,600-volt busbars current is led to the 6,600-volt synchronous motors through hook switches and automatic oil switches equiped with overload relays. The battery switchboard equipment consists of two-end cell switch indicators, two ammeters, two sets of knife-selector switches, one bus voltmeter, one low-reading cell voltmeter, bus voltmeter switch, recording voltmeter and ampere-hour meter for each side of the three-wire system.

The direct-current output of this station is delivered to the 115-230-volt network through twelve 230-volt feeders connected to the busses by knife switches and are provided with Weston edgewise ammeters on each polarity.

Substation No. 2 is located at 24 South Fourth Street and is similar in every respect to substation No. 1. The building structure is identical, as is its alternating and direct-current equipment. These two stations are connected together and to substation No. 3 by 230-volt tie lines.



INTERIOR OF SUBSTATION NO. 2.

Substation No. 3 is located at the corner of Tenth and St. Charles Streets, directly opposite the general offices of the company, and in the same building as the Tenth Street generating station. This station contains apparatus for transforming 6,600-volt, three-phase, twenty-five-cycle current from the Ashley Street station into energy for the 115-230-volt and 250-500-volt, three-wire distribution systems. The extensive series street lighting system also receives a majority of its energy from this substation.

There is installed in this station five 1,050-kilowatt National motor-generator sets; one 500-kilowatt National three-unit motor-generator set, comprising a 525-kilowatt, 6,600-volt, three-phase, twenty-five-cycle synchronous motor driving two 125-volt, shunt-wound, direct-current generators; two Westinghouse twenty-five-cycle, 500-kilowatt, 550-volt rotary converters, one Westinghouse balancing set, comprising two fifty-kilowatt, 250-volt compound wound machines on the same shaft; one Western Electric, motor-driven, three-wire booster set; six three-unit arc light motor-generator sets; five General Electric, 6.8-ampere, seventy-five-light, 6,600-volt, twenty-five-cycle, constant-current transformers with mercury arc rectifiers, and three General Electric, four-ampere, seventy-five-light, 6,600-volt, twenty-five-cycle, constant-current transformers and mercury arc rectifiers. There is also installed a Chloride Accumulator of 296 cells.

The incoming feeders enter the basement and are carried to the upper floor of the station to the high-tension switch structure, where they are arranged in a similar manner to those in substation No. 1. The incoming lines and the motors and rotaries are equipped with switches, instruments and relays also similar to those described for substation No. 1. The low-tension board and high-tension control bench are located on an enclosed gallery at one end of the combined engine room and sub-

station. The switchboard is arranged around the four sides of the gallery, with the bench control immediately in front of the windows overlooking the main floor of the station. The generators and direct-current side of the rotaries on all outgoing low-tension feeders are equipped with the same instruments and switches as at station No. 1. All cables and wires are carried in ducts wherever possible and elsewhere are thoroughly fireproofed. The entire structure is fireproof and no insulation except fiber or slate has been left exposed.

Twenty-two feeders supply the 115-230-volt network from this substation, and twelve feeders supply the 250-500-volt network. Substation No. 3 is provided with a tie line conecting its 230-volt busses with the 230-volt busses at substation No. 4. The series arc lighting apparatus in this station is operated on an all-night schedule of approximately 4,100 hours per year, and supplies current to 1,850 series direct-current lamps, of which 1,182 are the enclosed carbon type, 6.8 ampere, 450 are of the magnetite 6.8-ampere type, and 218 are of the magnetite type. By September, 1910, all of the enclosed carbon lamps will be replaced by 6.8 ampere magnetite lamps.

Substation No. 4, located at Twentieth and Locust Streets, suplies 115-230-volt direct-current to the underground mains and also sixty-cycle alternating current to part of the overhead or outlying district. The equipment of this station comprises two 1,050-kilowatt National motor-generator sets and one 525-kilowatt, three-unit motor-generator sets. This station supplies the Edison network through eleven 230-volt feeders, and the sixty-cycle energy is distributed to the alternating-current distribution system over five four-conductor cables, each phase being equipped with voltmeter, compensated for line drop, and ammeter, recording wattmeter, automatic oil switch and Stillwell regulator.

Substation No. 5 is used to supply sixty-cycle alternating current to the overhead district. This station is located in a building erected in rear of the Union Electric company's electric vehicle garage on Morgan Street, near Vandeventer Avenue.

The equipment comprises four 1,050-kilowatt National frequency changer sets, converting 600-volt, twenty-five-cycle energy into 2,300-4,000-volt, three-phase, sixty-cycle energy. On the shaft of each set is mounted a fifty-kilowatt, 125-volt exciter. There is also a 525-kilowatt, three-unit set, comprising a 6,600-volt, twenty-five-cycle synchronous motor driving a 300-kilowatt, 500-volt generator and a 200-kilowatt, 125-volt generator. In addition there is a 300-kilowatt, sixty-cycle, three-phase, 500-volt Westinghouse rotary converter which serves in upholding the voltage on the 500-volt network in the western section of the city. For supplying current for charging vehicle batteries there have been provided two fifteen-kilowatt motor-generator sets, comprising 125-volt, direct-current generators driven by Wagner 230-volt, sixty-cycle, single-phase motors.

Energy is received from the Ashley Street station over eight three-conductor cables, four of which are at all times employed for sixty-cycle distribution. The incoming lines from Ashley Street are controlled on a brick structure carrying General Electric motor-driven oil switches. Outgoing feeders are controlled by single-pole selector oil switches mechanically interlocked.

Substation No. 6 is located in the engine room of the Ashley Street generating station and is used chiefly as the distributing center for a portion of the sixty-cyle, alternating-current output. The switchboard of this substation is a three-story structure with its floors on the same level and communicating with the galleries of the Ashley Street station switchboard. The duplicate sixty-cycle busses are at the top of the switchboard and are arranged in a massive brick structure, on which are also mounted the oil switches, disconnecting switches, selector switches and potential transformers for the sixty-cycle tie lines. The second floor is occupied by the distributing busses, the automatic induction regulators and the automatic remote control feeder switches. The ground or engine-room floor contains the distribution feeder panels with all the instrument and control apparatus.

Substation No. 7, located at 715 St. Charles Street, is used for the distribution of direct-current energy and furnishes current for driving a large electric exhaust fan used to exhaust smoke from the railroad tunnel approach of the Eads Bridge. The equipment of this substation consists of three 300-kilowatt, sixty-cycle, 500-volt rotary converters. There is also a battery of 280 cells.

In addition to these substations the Ashley Street station supplies large quantities of 6,600-volt, twenty-five-cycle, three-phase energy to three rotary converter substations of the United Railways Company, of St. Louis. These transmissions are also by means of underground lines and the instruments and auxiliary apparatus are similar to those contained in the substations of the Union Company.

DISTRIBUTING SYSTEM.

Many novel and commendable features are embodied in the line construction of the Union Company's distributing system, chief of which may be mentioned the conduit construction, the various devices used in the overhead construction, and the unique methods employed in laying cables, trimming arc lamps, etc.

An ordinance passed some years ago requires all electric wires in the downtown district of St. Louis to be placed underground. This ordinance also directs that companies operating light and power lines should occupy joint conduits, designated as high-tension subways, and should be confined to one side of the street, while the telephone and telegraph companies should occupy similar low-tension subways on the other side. Since the passage of this ordinance, practically all of the joint subways have come into the possession of the Union company through various consolidations and purchases. The joint subway owned by this company comprises about 1,747,000 duct feet.

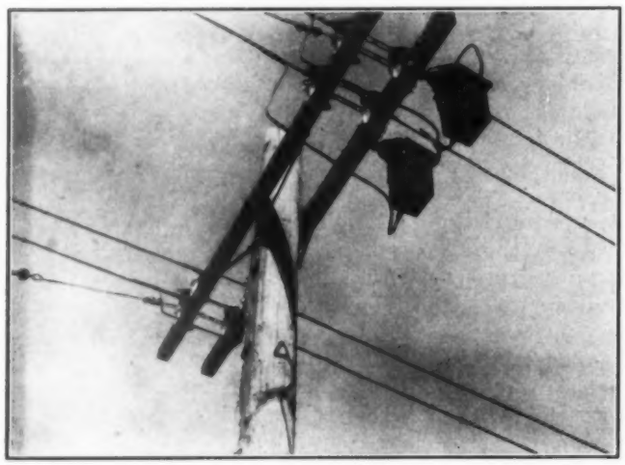
In addition to the subway lines which the Union company has acquired or constructed under its own rights, it owns a one-half interest in the National Subway Company, of Missouri, a company privileged to construct subways in any part of the city and to rent duct space to others. As this company has approximately 842,000 duct feet of conduit installed, the underground plant of the Union company thus comprises about 4,500,000 duct feet, of which about 2,000,000 duct feet are within the downtown district.

A part of the subways of the Union Electric Light and Power Company and the National Subway Company is constructed entirely of concrete, and is designated as "Monolithic" conduit. As shown in the accompanying illustration, wooden duct-molds of U-shaped

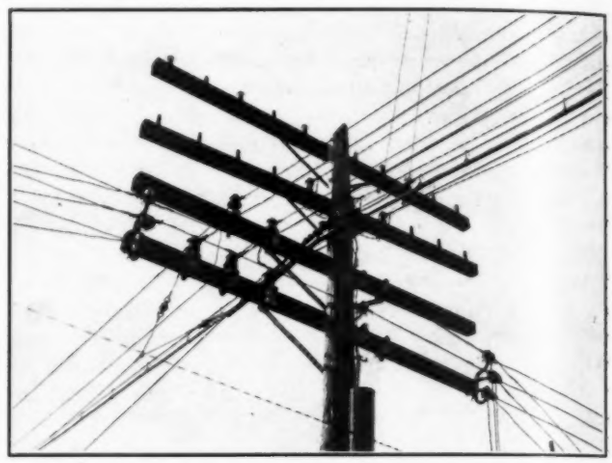
sections and sixteen feet in length are set into position on accurately aligned supports on the bottom of the trench. Concrete is then dumped into place around the molds and struck off even with their tops by means of a straight edge attached to a long handle. After the concrete has taken its initial set, which usually occurs in about three hours, the forms are withdrawn, leaving smooth, straight, continuous open grooves which form the duct passages. Thin molded concrete plates or slabs are then laid across the open ducts and the latter covered with concrete. By introducing suitable molds, branch junction-boxes can be cast at any point without additional expense. This type of conduit construction has been shown to be entirely fireproof, even under conditions of severe electrical fires in the conduit.

The manholes in the underground system number about 500, are placed about a block apart, and are of both brick and concrete construction. There are also about 2,000 distributing manholes. Where the cables pass through manholes they are fireproofed with a half-inch coating of Portland cement mortar.

The underground construction and repair department has two large motor-driven trucks, fitted with winches for drawing in cables. One truck is arranged with a separate motor for driving the winch head, while in the case of the other the winch head is driven by the motor of the vehicle itself. With one of these trucks a crew of six men and a foreman can draw in from 3,000 to 5,000 feet of cable per day. A cable reel is hauled behind the truck on the way to work, the members of the crew, and all the auxiliary apparatus, steel rope, sheave skids, etc., being carried on the truck. Rodding ducts is accomplished by the use of sixteen-foot wooden slats purchased at low cost, and put together with common baling wire.



APPLICATION OF METAL CLAMPS AND SPACERS.



VIEW SHOWING USE OF SPREADER IN PLACE OF BUCK ARM.

All low-tension feeders enter cast-iron junction boxes mounted on the walls of the manholes, the feeder cables being directly connected to the junction box busbars. The main cables are connected to the busbars through copper catches designed to blow at several times the maximum capacity of the cable. Main and feeder junction boxes are located at each street intersection, facilitating the sectionalizing of cable mains and Edison tubes. The total underground cable of all kinds constitute a length of approximately 345 miles.

VIEW OF SPECIAL TYPE OF CONDUIT CONSTRUCTION.

On account of an ordinance limiting the number of poles erected in a street and also because of there being two competing telephone companies in the city of St. Louis, the lighting company is forced to use poles for overhead construction jointly with these companies. Also the telephone companies being the first in the field, occupy the top cross arms on their own poles, and the lighting company is compelled to occupy the undesirable lower arms.

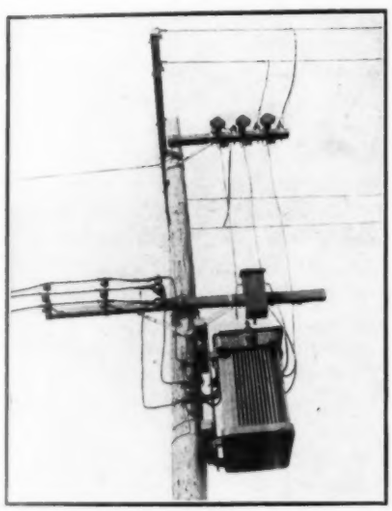
Certain unusual and improved methods of construction are used in the overhead lines of the Union Company. All incidental work, such as shaving, gaining, boring, painting, seasoning, etc., is done in the pole yard of the company to eliminate, as far as possible, all field work. Pole settings are made to a standard depth filled with thoroughly tamped excavated material, to within twenty inches of the surface, and left until completely settled. Concrete is then poured around the pole, forming a cylindrical collar twenty inches deep and four inches thick. This collar protects the pole from decaying, besides increasing its apparent section.

In one of the accompanying illustrations there is shown a view of a cross arm on one of the Union Company's lines, which is equipped with metal clamps, each fitted with insulators. These clamps have been exclusively employed in the Union Company's overhead construction. By the use of these clamps when applied to an insulator pin, the reduced useful section of the ordinary cross arm due to the large holes, is avoided, and instead of producing a splitting section, which tends to destroy the arm, the clamp encompasses the wood, increasing the ability of the

cross arm to withstand the strains produced by the line attached to the pin. This device is also very useful in strengthening split of checked cross arms which would otherwise have to be changed. The clamp element is in shape that of the cross arm section, being split at the diagonal corners and drawn tight by bolts which cause it to seat itself squarely on the wood on all four sides.

Realizing the necessity of precautions to protect employes having occasion to climb poles, the Union Company has adopted a standard spacing between pole pins which allows ample room to climb a pole without coming in contact with primary circuits.

The grounded neutral is invariably



THREE-PHASE TRANSFORMER MOUNTED ON POLE.

carried on one of the pole pins, which further lessens the danger of climbing poles or working on lines. In order to decrease any interruption to service due to devices grounding out of the pole or cross arm in wet weather, all primary fuse-blocks, switch boxes and demand meter boxes are mounted on cross arms by means of special brackets and standard line insulators, relieving the strain on the insulation of the devices.

A special feature used for protection of its lines has been employed by the Union Company, which limits the flow of current to ground through the lightning arresters in case of failure of the arrester and at the same time leaves visual indication of trouble in the arresters for the benefit of the inspector. This cutout is installed in the line side of the arrester connection and is so arranged that if shattered the connecting wires will fall in the clear.

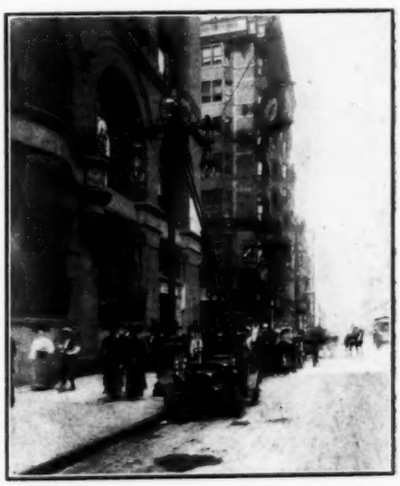
In order to overcome the restrictions of the city in preventing the use of racks built on poles for carrying large transformers, the Union Company has adopted three-phase pole type transformers in large sizes, which have been specially manufactured according to specifications of the Union Company. These transformers range in size from twenty to seventy-five killowatts and are mounted on regular line poles as shown in one of the accompanying illustrations. These three-phase transformers, while especially intended to supply power service, are arranged so that light service at 115-230 volts may be supplied from one phase, thereby saving the installation of an additional lighting transformer in many cases. There are at present over 2,400 transformers ranging in size from one to 100 kilowatts installed on the company lines.

A special line wagon used by the overhead line department is shown in one of the accompanying illustrations. A feature of this wagon is that the apparatus is arranged in the order of its use after arrival at a job. The ladders are carried on top and serve as a seat for the men. Places are also provided for the various materials, such as rubber goods, torches, etc., while the glass insulators are carried in trays under the wagon body. Material for a full day's work is carried in each wagon, as well as all necessary tools. For stringing up or taking down lines of wire the wagons carry a ten-horsepower 500-volt motor, which is belted and geared to a shaft on which can be mounted a winding drum for pulling in rope or a wire reel. This outfit can be placed in position ready for work and eliminates the services of two men. The motor receives its current from any convenient trolley wire or 500-volt main of the company.

The Union Electric Light and Power Company maintains a completely equipped and thoroughly organized trouble department which is handled by three foremen, having under them a corps of inspectors and electricians. The company also maintains a repair department which looks after all repairs of apparatus, installing motors, transformers, etc. The company also keeps on hand a large stock of motors to lend to customers while their motors are being repaired, and this department also inspects customers' power installations at frequent intervals and leaves written memorandums of the condition of apparatus.

The Company maintains a completely equipped laboratory for the calibration and repair of all meters. This laboratory is operated in connection with the meter department which has charge of all meters in stock and in service, and the repair of same. The service meters are tested in accordance with a schedule which is based on the character of the meter, its size and the class of service it maintains. All meters are tested in place on the customers' premises.

The Union Electric Company occupies a four story brick building, sixty by ninety feet, at the corner of Tenth



ARC-LAMP TRIMMER'S AUTOMOBILE IN SERVICE.

and St. Charles streets. The first floor is used as a show room and for receiving tellers, and for the contract and commercial departments. On the second floor is located the bookkeeping, billing and electrical engineers departments. On the third floor are located the offices of the president and general manager, chief engineer of power plants, purchasing department, automobile department, solicitor's room and drafting department. The fourth floor is used as a blue print room in connection with the drafting department.

The only exclusive garage and charging station in St. Louis is operated by this company, at 3916-22 Morgan Street. About three years ago, there were only approximately thirty-four electric vehicles and trucks in St. Louis and at that time, a garage was designed with space for eighty machines, while pro-

vision was made for charging sixty-four vehicles at one time. The present number of electric cars and trucks in use in St. Louis is about 375 and there are nine agents selling twelve different makes of electric vehicles. There are forty-six private electric garages equipped with mercury rectifiers for charging purposes. The Union Electric Company receives $35 per month as garage charges for each pleasure car and this amount includes the charging of cells, inspection and calling for and delivering machines. There are about seventy automobiles cared for in this manner and seventeen men are employed about the garage. The Company acts as sales agent for two standard makes of electric vehicles (Rauch & Lang and Studebaker), both trucks and pleasure cars. The present garage is now becoming taxed for space and the Union Electric Company is arranging to fit up one of the old stations at 20th and Locust Streets with charging and storing facilities for 150 trucks. After this new garage is opened, the present garage will be used exclusively for pleasure vehicles.

There are about 200 electric signs in St. Louis containing approximately 40,000 lamps. The Union Electric Company has recently installed a sign forty-five feet high by thirty-five feet wide on the roof of the building at 820 North Broadway, containing 1,500 four-candlepower lamps. This is a spectacular power sign and may be seen down Broadway through the glare of many magnetite arc lamps for a distance of one mile.

The gross revenue of the Union Electric Light and Power Company for the year ended December 31st, 1909, was $3,085,614, from which was paid the operating expenses, taxes and reserves amounting to $1,503,034, and an accrued interest of $834,204, leaving a net income of $748,376.00. In the year of 1909, $593,100 was paid in dividends to the stockholders at the rate of six per cent per annum on the capital stock, leaving a surplus for the year of $155,276. For the preceding year of 1908, the total revenue from all sources were $3,013,297. Out of this were paid the charges for operating expenses, taxes, rent and depreciation, total $1,551,156 and $805,499 in interest due, leaving earnings of $656,642. After paying the annual dividends above named, the surplus for 1909 amounted to $63,542.

As regards electric service the territory surrounding St. Louis is divided into two nearly equal sections with Clayton Road as the dividing line and each section is supplied with electricity by a separate company although both are presided over by the same executive.

Referring to the accompanying plat, it will be noticed that the city of St. Louis and the Mississippi River form the eastern boundary of the county. The territory extending nine miles west to Fern Ridge and seven and one-half miles north to Ferguson is the section served by the King Electric Company and the territory extending five miles west to Kirkwood and nine miles south to the Government Reservation, known as Jefferson Barracks, is the territory served by the Suburban Electric Light and Power Company.

The King territory comprises about fourteen towns and sub-divisions and the Suburban territory comprises about eleven towns and sub-divisions. The population of these towns and sub-divisions ranges from fifty to 8,000. The connected load of the Suburban Electric Light and Power Company is 500 kilowatts and that of the King Electric Company, 1,200 kilowatts. The load of the former is principally a residence lighting one while the load of the latter includes several large power consumers. Both companies supply both direct and alternating to their customers.

The King Electric Company receives its current from the lines of the Union Electric Light and Power Company, of St. Louis, at Wellston, where it passes through a controlling switchboard, is measured and distributed to the various lines. Among the power consumers in this territory served by the King Company, may be mentioned the Lewis Publishing Company, having a connected load of 400 kilowatts; Delmar Gardens, an amusement park, having a connected load of 400 kilowatts and Suburban Gardens, another amusement park having a connected load of 300 kilowatts.

The Suburban Electric Light and Power Company also purchases its current from the Union Electric Light and Power Company, of St. Louis. Current is received at the switchboard at Webster Groves, and after being measured is conducted to the various towns supplied.

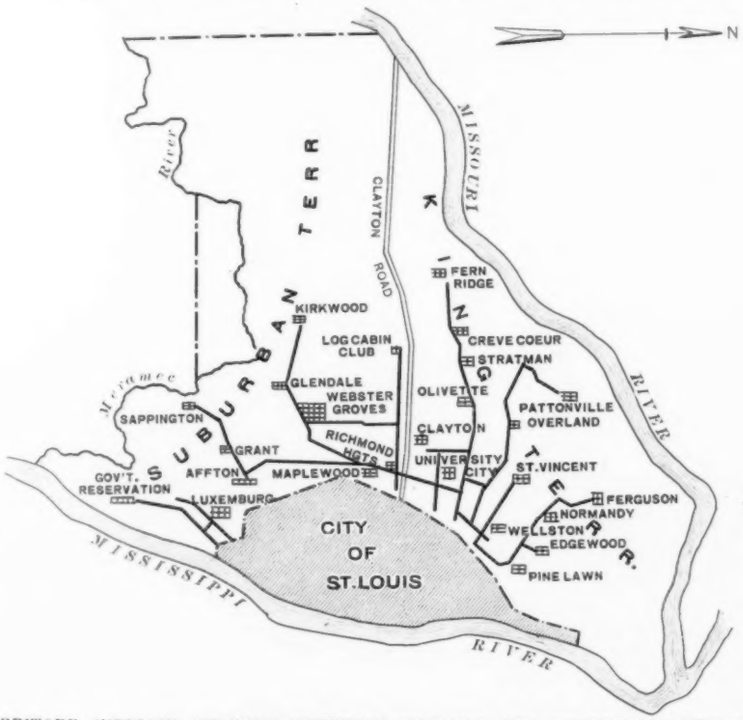
Overhead lines constitute the greater part of the transmission system of these two companies, the underground form of construction only being resorted to in a few of the larger towns. The same

VIEW OF SPECIAL REPAIR WAGON.

UNIQUE METHOD OF DRAWING IN CABLES.

features as applied to the transmission system of the St. Louis Company and described at considerable length above, applies to the lines of the two suburban companies.

Street lighting in the various towns is receiving more or less attention from citizens of the several towns as well as from the two electrical companies and there will shortly be installed uniform



TERRITORY SUPPLIED BY KING ELECTRIC COMPANY AND SUBURBAN ELECTRIC LIGHT AND POWER COMPANY.

systems of 6.6 amperes series tungsten street lamps. The units used will be of the forty-watt size.

Arkansas Association of Public-Utility Operators.

The Arkansas Association of Public-Utility Operators held its third annual convention at Pine Bluff, Ark., on April 27, 28 and 29, last. About fifty members were present representing the various central-station, gas, water and street-railway companies of the state.

In his presidential address, B. C. Fowles stated that Arkansas only needed more capital invested in developing its valuable resources in order to become one of the most important states in the country. Mr. Fowles proceeded with a review of the year's advances and deplored an adverse decision of the state courts by which public-utility companies are required to continue service to customers who are behind in their payments. He predicted that in all probability this ruling would lead to the practice of requiring a cash deposit from customers to cover possible shortages. Among other matters touched upon by Mr. Fowles was the necessity for public-utility companies to secure the good will and confidence of their customers.

W. L. Wood read a paper on "The Effect of Natural Gas Upon Municipalities" in which he showed that as a fuel in the boiler room natural gas shows a saving of fifty per cent over the cost of coal. The case he cited was that of the Texarkana Company where a price of ten cents per 1,000 cubic feet of natural gas is equivalent to coal at $1.50 per ton, and a saving of $220.00 a month is effected in labor in the boiler room.

The question of lowering the rates for electricity to compete with natural gas was discussed by D. A. Hegarty who advised electric companies to maintain their rates undiminished, so that they would not be embarrassed by having to raise their rates again in a few years when the supply of natural gas gave out, as had happened in several instances.

Mr. Hegarty presented a paper on "A Law for the Prevention of Theft of Electricity, Gas and Water from Public-Service Corporations." In the discussion that followed this paper, W. L. Wood recommended the use of metal-inclosed block terminals in all downtown istallations, and J. E. Cowles proposed inclosing all service wires up to the meter in conduit. Other plans were also discussed.

Louis Friedman read a paper on "Modern Apparatus for Street Illumination" in which figures were submitted showing the cost of various systems of arc lighting and the results of tests on the relative illumination afforded by series-tungsten luminous-arc and other methods of street lighting.

J. D. A. Cross read a paper on "The Extension of the Electric Heating and Cooking Device Business." He stated that an electric toaster will ordinarily consume about six kilowatt-hours a month, and recommended that the electric companies should make an advance of about twenty-five per cent over and above the cost price of electrical apparatus to allow a margin for advertising and for protection to local dealers. His experience was that of the apparatus put out on approval, about eighty per cent of the irons, sixty per cent on the toasters and fifty per cent of all other devices, are accepted, a result he considered as showing the efficiency of this method.

Felix Borden read a paper on "Illumination from a Contractors' Standpoint" in which he recommended the use of illuminating units of comparatively low brilliancy.

A paper on "Public-Service Corporations," by J. E. Cowles discussed principally the effect of some recent legal rulings in Arkansas relating to public-service companies.

A paper entitled "Customers' Accounts," by W. J. Thorp was an account of the bookkeeping methods used by the Little Rock Railway and Electric Company.

The present officers of the Association were unanimously re-elected.

A movement was set on foot having for its object the formation of a tri-state organization of the Arkansas Association with the public utility companies in Mississippi and Tennessee.

A feature of the entertainment part of the convention was the honoring of the blue badges of the association for free transportation on the street-car lines in the city and for admission to local places of amusement.

American Society of Mechanical Engineers.

It has been announced by the Meetings Committee of the American Society of Mechanical Engineers that the regular spring meeting will be held in Atlantic City, N. J., from May 31 to June 3. The joint meeting in England in July is an additional meeting.

A programme of especial attractiveness both professionally and socially, has been prepared for those present at Atlantic City. Among other things there is to be a reception followed by conferring honorary membership on Rear-Admiral George W. Melville.

H. G. Reist will present a paper of especial interest to electrical men, on the subject of "Gas Engines for Driving Alternating-Curent Generators."

Three-Phase Arc Lamp with Four Carbons.

A new arc lamp for use on three-phase circuits, which does not require any new or complicated regulating mechanism and is said to operate well at high or low power, has been constructed by an engineer, Aldo Righi. Three carbons of eight millimetres diameter are arranged like the corners of a triangular prism of equal sides of twelve to fifteen millimetres and connected to the three phases; they are in a vertical position and take the place of the lower carbon of an ordinary single-phase lamp. The upper carbon of about twenty millimetres diameter, the axis of which coincides with that of the prism, is suspended in such a way that it can come in contact with the three lower carbons at the same time. Generally the fourth carbon is insulated.

The arcs forming between the points of the three carbons and that of the fourth, form a star-connetion in the circuit. As there are six craters disposed in such a way as to direct the luminous rays chiefly downward, reflectors are unnecessary and a very steady light is obtained, comparable to that of a direct-current arc. The connections to the regulator are made so that the heavy-wire coil is inserted in one phase and that the other is either in parallel between two phases or between one phase and the fourth carbon, according to the tension employed.

An interesting phenomenon observed with this lamp is that if the arc is started in any manner between the three lower carbons, and the fourth one is gradually lowered, but not sufficiently for the upper craters to form, no appreciable variation is observed either in the intensity of the light or current consumption. But when the upper craters are allowed to form by lowering the carbon still more, a decrease in current consumption frequently takes place; while the light, which was at first flickering and reddish, becomes steady, white, and increases considerably in intensity. This is explained by the fact that the number of craters has been doubled. The lamp should be partiularly useful for electric railways employing three-phase current of low frequency, which are now compelled to use incandescent lamps or other sources of light for the illumination of their stations—*Translated and abstracted from La Lumiere Electrique (Paris), April 9.*

Wireless Companies Consolidate.

A number of wireless telegraph companies have recently consolidated under the name of the Continental Wireless Telephone and Telegraph Company. The corporation has organized under the laws of New York, and has a capital of $5,000,000.

The plans of the consolidated companies contemplate transcontinental commercial business, as well as the continuance of the marine reports and shipping messages which have up to this time constituted the greater portion of wireless endeavors.

The new company will enter into competition with the old wire telegraph companies for commercial and public patronage and its promoters say it will mean a considerable reduction from the tariffs now in force by the old telegraph concerns.

The companies to form the consolidation are the Massie Wireless Telegraph Company, Clark Wireless Telephone and Telegraph Company, Pacific Wireless Telegraph Company, the Collins Wireless Telegraph Company of Newark, N. J.

The officers of the Continental Wireless Telephone and Telegraph Company will be: President, F. T. Davis of Philadelphia; vice-president, Walter W. Massie, of New York; general manager, Thomas E. Clark of Detroit, Mich.; technical director, A. Frederick Collins, of Newark, N. J., the inventor of the wireless telephone. Headquarters' offices will be in New York.

Practical Application of the "Singing Spark" System.

The steamer "Cap Blanco" of the Hamburg-South America Line, was the first German vessel to receive a station of the new Telefunken system employing "singing quenched sparks," with a primary energy of about two kilowatts. During the first voyage the installation gave excellent results. The vessel left for Buenos Aires on November 5, 1909, and remained in communication until the seventh with various shore stations in Germany, Holland and England.

On November 9 telegrams were exchanged with St. Marie de la Mer near Marseille (1,000 kilometres) and Algiers (1,200 kilometres); on the tenth with Scheveningen (1,250 kilometres) and Bolthead (940 kilometres); on the eleventh and twelfth again with St. Marie de la Mer (2,250 kilometres) and Algiers (1,630 kilometres). During the entire trip the steamer also was in communication with numerous vessels at sea, and distances of up to 2,240 kilometres were bridged. Later it turned out that correspondence carried on between the steamer and St. Marie de la Mer on November 12 had been perfectly received by the Heligoland station at a distance of 3,330 kilometres. This reach of a station on shipboard is all the more remarkable as there were extensive stretches of land with high mountains between sending and receiving stations. From reports of other stations it appeared, furthermore, that the signals given with the new Telefunken system are easily distinguishable from all other signals and surpass them in strength, and that during atmospheric disturbances, which made the working of all other systems impossible, the singing spark telegrams could generally be received with ease.—*Translated and abstracted from Elektrotechnische Zeitschrift (Berlin), April 14.*

Mexican Telegraph.

The Mexican Telegraph Company reports operating revenue for the quarter to March 31, 1910 (partly estimated) of $205,000; net, $161,500; interest on deposits, $27,000, which, after deducting $9,500 Mexican Government's proportion of earnings for the quarter, leaves a balance of $179,000. Dividend of $89,735 was declared in April, leaving an estimated addition to surplus of $89,265.

The First Convention of the National Electric Light Association.

The Full Report as It Appeared in the Electrical Review, March 7, 1885.

The first suggestion of a definite organization of the electric-lighting interests of the United States and Canada was contained in the accompanying editorial announcement that appeared in the ELECTRICAL REVIEW of January 17, 1885, which is presented herewith in facsimile.

This announcement had been preceded by several editorial suggestions that such an association should be formed, and immediately following its publication the ELECTRICAL REVIEW received many letters endorsing the call and favoring the date and location. The far-seeing editorial eye had again, as often before and since, been the means of getting progressive forces to organize and unite for mutual good. At first several of the companies engaged in manufacturing electric-light apparatus, and that were licensing local lighting companies, were lukewarm about the benefits likely to result from the convention, but this feeling soon gave place to hearty cooperation, and the National Electric Light Association has been a successful, growing and valuable organization for its members from the day it was formed.

The first report of the meeting was telegraphed to the ELECTRICAL REVIEW, and appeared briefly in that journal, published in New York, February 28, 1885. The following week a report in detail was published, and is presented here in full. The discussion is of much interest, as indicating the state of the art and practice at the beginning of the year 1885. The report is taken from the columns of the ELECTRICAL REVIEW exactly as printed on March 7, 1885, and there is appended a list of attendants that was published in the same issue:

From Electrical Review, March 7, 1885.

THE ELECTRIC LIGHT CONVENTION.

REPORT OF THE PROCEEDINGS.

Representatives of the various electric light companies and interests, to the number of upwards of 100, met in the city of Chicago, at the Grand Pacific Hotel, Feb. 25th. The convention was called to order at 11 A. M., by Wm. A. Hovey, of the ELECTRICAL REVIEW, who stated that the call had been issued on the request of a large number of those engaged in the electric light business, and that the objects were to perfect a permanent organization, arrange for annual meetings and the discussion of such questions as would be of interests and benefit to all members of such a convention. George S. Bowen, of the Van Depoele Company, of Chicago, was elected temporary chairman, and H. D. Stanley, of the Bridgeport Electric Light Company, Secretary *pro tem.* Mr. Bowen, on taking the chair, alluded to the embarrassments and depression that had been felt in the electric light business during the past year. The appliance of the light was but yet in its infancy, and many difficulties had surrounded it. During the last twelve months those in the business had been subjected to peculiar trials, but he had every reason to apprehend a brighter and more prosperous future, which he hoped would be inaugurated this year, and he was confident that some substantially valuable results would grow out of this convention, including as it did many well-known representatives of both the manufacturing and operating divisions of the business from all parts of the country.

A committee on credentials and permanent organization was appointed, consisting of the following gentlemen: C. A. Brown, Chicago; C. J. Richards, Racine; G. H. Wadsworth, Cleveland; Frank Ridlon, Boston; and S. Baldwin, Baltimore. Also a committee on programme and progress of business, consisting of Messrs. Randolph, Crossman, Reid, Scribner, Buckley, Hovey and Bowen.

At 2 P. M. the convention was welcomed to the city of Chicago by Mayor Carter Harrison. He hoped that their deliberations would be careful and wise, and out of their deliberations there might be more light. They had to deal with the most subtle of fluids. It was the greatest agency handled by men. No man knew its power, but that should not discourage them. Electricity was the breath of the Deity. It was all powerful, yet harmless, when not too contracted. It was for them to work so that it might be harmless. He touched upon the recent telephonic achievement of talking from Chicago to New York; alluded to the increased facilities of the sub-marine cable service, and ended by speaking of electricity as "a giant force, powerful enough to rend the ancient oak and melt down the granite of ages, yet in the incandescent light it was made as soft as the down upon a woman's cheek, while in her glossy tresses it aroused a

From Electrical Review, January 17, 1885:

...should not lo...
...path of prosperity upon which it ...ntered.

THE ELECTRIC LIGHT CONVENTION.

We are requested by the representatives of a large number of electric lighting companies to print the following announcement:

A convention of delegates, representing companies doing an electric lighting business in the United States and Canada, will be held at the Grand Pacific Hotel, Chicago, on Wednesday, February 25, 1885. Every electric lighting company in the United states and Canada is invited to send delegates properly accredited. Delegates will find headquarters established at the Grand Pacific on their arrival.

...the ... of the American ...

spark, even if it did not generate one."

Prof. Elisha Gray was then called for and spoke of electricity as the greatest wonder of the century, of its need of development, and predicted that we were but standing on the threshold of its windows.

The committee on organization reported the following for officers of the convention: President, J. F. Morrison, of Baltimore; Vice-Presidents, H. M. Cleveland, Hartford, and J. H. Yarborough, of Nashville; Secretary, W. A. Hovey, ELECTRICAL REVIEW; Charles A. Brown, of the Western Electric Company, presented a gavel to the new President, remarking: "It represents a commutator on an electrical light, and I trust that the convention in its deliberations will have as cohesive a number of segments."

Mr. Morrison thanked the convention for the honor, and in a brief, practical address opened the convention for the business that had brought many of the members hundreds of miles.

The committee on digest of papers and programme of business reported the following order of proceedings and topics for discussion:

1. Incandescent light, particularly in regard to length of circuit upon which they can be run with a profit.
2. Locating and avoiding crosses with telephone wires.
3. Power and its conversion into light.
4. Electric light globes and shades.
5. The best modes of connecting dynamos with power.
6. Electric lighting by water power.
7. Rates and rebates on electric lights by the year.
8. The use of electricity as applied to motors.
9. Where an electric-light system requires No. 6 conductor, is it desirable to use Nos. 6 and 4 in the same line?
10. Will armatures become affected by frost when exposed in transportation?
11. Special insulation or guards to insulation of lines at dangerous points and places.
12. Street lighting—the best manner and modes of accomplishment, embracing the location of lights and running of circuits.
13. Experience and results in the use of underground conductors.
14. *Resolved*, That the fireman should receive more pay than the engineer.
15. Help generally.
16. Experience of electric-light companies in the use of copper-coated and uncoated carbons.

A letter from Mr. A. S. Hibbard, superintendent of the Wisconsin Telephone Company, addressed to Mr. C. A. Brown, Chicago, relative to the respective rights of telephone and electric-light companies was read by the president and submitted to the consideration of the meeting. The writer felt that the telephone interest should be considered by the electric light convention, if only for the purpose of discussing the mutual rights and equities in overhead wires. The telephone man's complaint against the electric light companies is that in a number of instances the rights of the telephone companies are disregarded entirely. They allege that the light men have built lines along the same side of the streets with the telephone wires, either above them or underneath them. It was well known that there is a heavy reduction from electric light wires on to telephone wires, and as a result there were loud and disturbing humming noises on all telephones in all localities where the electric light wires were. Enough had been shown in the experience of telephone companies with the electric light to prove that there is danger in too great proximity. While they had no desire to place impediments in the way of the electric light companies, and wished to be friendly neighbors, they thought it would be best that they should be next-door neighbors, and not attempt to occupy the same house.

Professor Gray said induction troubles might be avoided, but this involved expense. Wires could be laid in the ground and so protected as to prevent induction, but there must be some conducting substance between the two wires. Lead pipes had worked well. Another way was by the metallic circuit. This would cost the telephone company two wires instead of one. There would be no danger from grounds, as the electric light company has the metallic circuit. There was no way to prevent crosses with overhead wires. The wires should go uppermost which was the more liable to stand. Where they cross at right angles there is no induction, only where they run parallel.

President Morrison said the question of induction was a bug-bear. Professor Gray had skillfully gone around the question and touched the telephone side of the question, avoiding the electric light companies' position. When the electric light was a success the telephone companies commenced the outcry against the electric light companies and desired the latter to go on other streets and keep out of the way of telephone wires. The electric light was not a luxury but a necessity, as much so as the telephone, and the light should be allowed to run on the streets if law and order was to be preserved and the police kept tolerably safe. A properly constructed electric light was not dangerous any more than a buzz-saw in a saw-mill. Telephone wires could be run alongside of electric light wires if insulation did not rub off. Every city, except Chicago, had given the right of way to electric light companies.

Mr. Hovey said that seventy-eight per cent of the fires in New York by wires were from those underground; there were twenty times as many wires overhead as underground. Professor Gray said the telephone and electric light interests were mutual. What was wanted was to arrange the circuit of the two systems to the best interests of both. He recommended the establishment of telephone and electric light stations for observations to trace out phenomena, and facts thus secured were better than theories. A recess was taken until 7:30 o'clock.

After the evening session had been called to order the subject of "Electric Lighting by Water Power" was discussed. George Fletcher, of Dixon, Ill., created considerable amusement by a description of his plant for furnishing electric lights. He said he employed water power, and was asked who his engineer was. He said the Lord furnished him an engineer in the shape of a turbine water wheel which was seventeen years old and cost $1,250. His carbons cost him fifteen dollars a thousand, and he ran thirty lights. The wheel ran a saw-mill and electric lights as well. The cheapness of this plant and Mr. Fletcher's manner of stating the facts convulsed the convention with laughter. "The best mode of connecting dynamos with power" was then brought up. Mr. Ide, of Springfield, then gave a description of the plant of his company, and was followed by Mr. Steward, of Chicago, who said the best means was belting direct from the machine to the dynamo. Mr. Weeks of Kansas City, was of the same opinion. Mr. Sperry, of Chicago, avoided a perpendicular belt. There was a disadvantage in using a too heavy or too thick a belt. President Morrison said the New York Company

at the start used the single pulley on the dynamo. This was abandoned, and a Corliss engine, with a gear-wheel, put on. In Philadelphia they had sixteen engines at the start, with sixteen dynamos, belted direct from the engine to the dynamo. This was too expensive, and two engines were introduced of twenty-five horsepower, driving the main shaft and belting down to the machines. In Baltimore their shafting ran the length of the engine-room, with two rows of dynamos. The engines were belted to the line of shafting. A Corliss engine was first used, and then Buckeye engines of different power. The Frisbey clutch-pulley was discarded, and a line of shafting put on top of the joists. The shafting of the dynamos was changed and tight and loose pulleys used, and since this was done no trouble had been experienced. It was his opinion that the friction clutches were useless.

Mr. Weeks, of Kansas City, inquired about the rocking-grate bar, but no one had used it. It was stated that washed screenings had been used advantageously. Inquiries were made concrning smoke-consumers, but it appeared the electric light companies did not use them. A skillful fireman was said to be better than the style of furnace in use. The use of blowers was favored by some and opposed by others. A variety of views were expressed concerning the utility of the Jarvis furnaces, which were highly commended by those using them.

"Rates and rebates on electric lights by the year" was considered. Mr. R. J. Randolph, of Rockford, said in winter they ran fifteen hours and a half in stores and dwellings. He ran three circuits, shutting down the lights at seven, eight and nine o'clock, and charging accordingly.

"The use of electricity as applied to motors" was discussed by Mr. Hovey. He thought the system had not gone beyond experimental points. To carry the current in high-tension form where it can be utilized was well worthy of consideration. The matter of motors had not gone beyond the experimental state. Scientific experts were not practical men, but they could overcome electrical disturbances by applying their theories to practice. Motors must be taken out of the laboratory. Some one must do it, and some one must lose money.

Mr. Van Depoele said electricity could be used for transmitting power. That much had been demonstrated. The power of a motor could be governed in the same way that an engine is. The speed would always be the same whether the load was increased or decreased. Mr. Sperry said motors could be run, and that much had been settled beyond a doubt. They would be used the coming summer in driving fans. Mr. Curtis said that Cleveland was using street cars with motor appliances. Mr. Hockhausen, of New York, said in Europe motors were a great success. In New York they were used to drive fans and cool offices, and work elevators. They were put there to show the system more than to make money out of them. The only practical railway in the country where the motor worked successfully was the one in Cleveland.

Field's motor he knew nothing about, especially as to its power. There was talk of putting a Daft motor on the Brooklyn Bridge. Mr. Wadsworth saw one in Boston in full operation. President Morrison thought the power of a company ought not to be diverted to motor purposes as it might be required by their customers. Several held to the contrary, relying on the fact that all of the power purchased was not always in use.

J. FRANK MORRISON.
The First President of the National Electric Light Association.

A resolution offered by Mr. Hovey for the appointment of a committee of five to consider and report upon the organization of a National Electric Light Association was adopted. The Chair appointed as such committee, Messrs. Hovey, Brown, Bowen, Bullock, and Sperry.

The next topic was, "Where an electric light system requires No. 6 conductors is it desirable to use Nos. 6 and 4 in the same line?" The question was decided in the affirmative. The convention adjourned at 11 P. M. to 10 A. M. Thursday.

Thursday's Session.

The convention assembled at 10:20 A. M., and the regular programme of addresses and brief discussions upon electrical subjects was then taken up, commencing with the consideration of "Special Insulation of Wires in Dangerous Places," the topic being opened by Mr. C. C. Haskins, the electric light inspector for Chicago. He described the proper standard of spaces to be observed between lines to obviate danger from friction and fire. In his judgment it was often safer to lay wires passing over woodwork close together, rather than apart. The escape of electric current from one wire to another when at some distance apart, if continued long, resulted in scorching and charring the woodwork, and then there was always some very excellent kindling wood when a spark did come. On the contrary, when the wires were reasonably close together the current could pass from one to the other without charring the wood. Mr. Robinson, of Providence, spoke of

his experience with wires gathering moisture in damp rooms, and Mr. Bell, of Minneapolis, and Mr. Place, of Chicago, spoke on the same topic.

The question whether frost would damage dynamos in transportation was answered in the negative by Mr. Van Depoele. Mr. Sperry agreed, but said the moisture from the thawing of the deposit of frost, if heavy, would be liable to be damaging.

"Incandescent Lighting and Length of Circuit" was considered, Mr. Sperry relating his experience in that line. Such lights, so far as the distance they could be worked, depended upon the resistance. Sir William Thomson's formula was the best one to be governed by. Mr. Wadsworth spoke of these lights in New York, where they were operated four miles and a half from the station. He did not know as to the economy of it. Mr. Ridlon said the same had been done in Boston. As to economy, he thought the gas companies might furnish the power. Mr. Van Depoele said automatic arrangements would have to be used. The best mode of propagating the light was the multiple arc system. Mr. Cleveland, of Hartford, said the length of the current required a central station, with substations one mile apart. This plan had been tried successfully by the Schuyler Electric Light Company, of Hartford, Conn. Mr. Place favored this plan, and discussed the topic at some length.

"Street Lighting" was brought up, and Mr. Bowen said there were many different systems—towers and also lamps hanging at the intersections of the streets. Nashville employed the latter system, and the lamp was perfectly fixed. As regards the economy, more light was obtained from a group of lights placed on a tower. Where cities were compactly built, the alleys were lighted by this system. Six lights on a tower did as much lighting as eighteen on poles. The city of Detroit had ninety towers and 350 lights, and it was handsomely lighted. Elgin was so lighted, and New Orleans, and the result was gratifying. It was the most economical way of lighting a city. The towers should not be too high. Mr. Weeks, of Kansas City, had found that the tower system gave dissatisfaction, especially where the streets run at angles. In Detroit there was dissatisfaction, and they favored the pole system. Quincy adopted the latter plan, and the light was cheaper than gas. The best method was by poles at the intersection of streets. Mr. Fletcher, of Dayton, agreed with Mr. Weeks. Committees had visited the different cities and found the pole system more satisfactory than the tower. In Dayton the duplex lamp was used, and water furnished the power. Mr. Randolph, of Rockford, said they had run lamps on wires stretched across the streets, and two lamps had fallen. He advocated the tower system, especially for small towns. It could not be done in Chicago, especially in the business portion of the city. Elgin, he said, was one of the best lighted cities in the United States, and every committee had so reported. Mr. Johnson, of Hyde Park, said that in Rockford, by its four lights on top of the Court House, every alley was lighted, and you could read a newspaper anywhere as if by a beautiful moonlight. He was converted to the tower system. Mr. Yarborough, of Nashville, said in his city posts were put up with arms to them, and during three years not a light had fallen. Mr. Montague, of La Crosse, Wis., said the wires across the street had been abandoned, and towers placed at the corner of the streets. The lamps were suspended on posts with iron arms, and the system was satisfactory.

A recess for dinner was taken, a number of the members improving the opportunity by visiting the large establishments of the Western Electric and Van Depoele companies.

On reassembling, "Copper-coated and Uncoated Carbons" was considered, George Wadsworth holding that copper-coated carbons were objectionable on the ground of obstruction to the lights and uncleanliness from the work of the trimmer. Mr. Van Depoele favored coated carbons where there was a low electric motive force and large current.

The committee appointed to consider the question of interference between electric light and telephone lines, reported that the question was principally one of construction, wherein both sides had duties. The following was recommended: Telephone lines to have metallic circuits; return electric light circuit to be on the same poles as the outgoing circuit, when possible; care to keep the electric light carefully insulated, and that all joints be soldered; electric light wires be suspended below the telephone wires; telephone companies use cable with induction killer and lightning arresters. The report was adopted.

The report of the Committee on Permanent Organization was then read by the chairman of the committee, Mr. William A. Hovey, of the ELECTRICAL REVIEW. It embodied a plan for a national association of those engaged in the business of manufacturing and operating the electric light in all parts of the country, and submitted a constitution and by-laws for such organization substantially as follows:

Article I.

The name of this association shall be the National Electric Light Association.

Article II.

The members of this association shall be companies, firms or individuals operating electric light plants or manufacturing electric light apparatus.

Article III.

Companies, individuals or firms engaged in the manufacture of machinery or apparatus connected with electric lighting may be admitted to associate membership by a vote of the Executive Committee. Such associate members shall pay the same dues as members, shall be entitled to seats at all meetings, but shall have no vote, shall be ineligible to office, and shall be entitled to the floor only at the request of the Executive Committee or presiding officer.

Article IV.

The officers of this association shall be a President, three Vice-Presidents, a Secretary and Treasurer, who shall be one and the same person, and six other members of the Executive Committee, of which the President, Vice-Presidents, and Secretary and Treasurer shall be members *ex-officio*. Five members shall constitute a quorum. All officers shall be elected by ballot at any regular meeting of this association, and shall hold their respective offices for one year, or until their successors are elected and qualified.

Article V.

The duties of the several officers shall be those usually pertaining to their offices.

Article VI.

The Executive Committee shall be the governing body of the association. It shall meet from time to time, gather and prepare information on all topics of interest, and submit reports at each meeting of the association.

Article VII.

At least one general meeting of the association shall be held each year, at such time and place as the Executive Committee shall determine.

Article VIII.

The entrance fee shall be ten dol-

lars for each member. Each member may be represented by a number of delegates not exceeding three, and shall be entitled to one vote.

Article IX.

The constitution may be amended at any general meeting of the association by a vote by ballot of two-thirds of those present.

Officers of the association were elected as follows: President, J. F. Morrison, Baltimore; Vice-Presidents, H. M. Cleveland, Hartford; J. H. Yarborough, Nashville; E. R. Weeks, Kansas City; Secretary and Treasurer, William A. Hovey; Executive Committee, George S. Bowen, Chicago; William Hochhausen, New York; Gilbert Donaldson, St. Paul; Frank Ridlon, Boston; John R. Fletcher, Akron, O.; and George O'Connor, New Orleans, and the officers above named.

The newly-elected officers of the national association were duly installed, and President Morrison made a short address, thanking the convention for the honor of selecting him as their permanent chairman, and congratulating them upon the results of a useful, interesting and harmonious convention.

Mr. George S. Bowen delivered a short farewell address to the assembly, expressing the gratification of the Chicago Committee of Arrangements at the large attendance in response to the call, and also upon the interest taken in the proceedings, closing with the expression of the hope that the "circuit of mutual sympathy and interest that had now been established would never be broken."

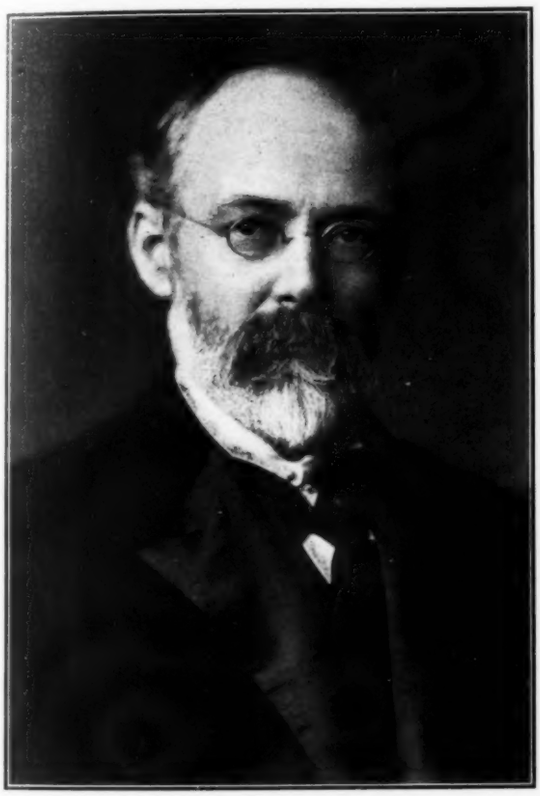
Resolutions thanking President Morrison for his impartial discharge of the duties of his position, the Grand Pacific Hotel for its many courtesies, and the press of Chicago for the full and correct reports, were adopted, and the convention adjourned *sine die*.

The Executive Committee held a meeting Thursday evening, and decided to call a meeting some time in July next, the place to be decided hereafter. Circulars will be sent to all members, asking their views on the topics to be discussed and the place preferred for holding the next meeting. The members quite generally favored the East, and New York, Saratoga, Atlantic City, and Put-in-Bay were suggested.

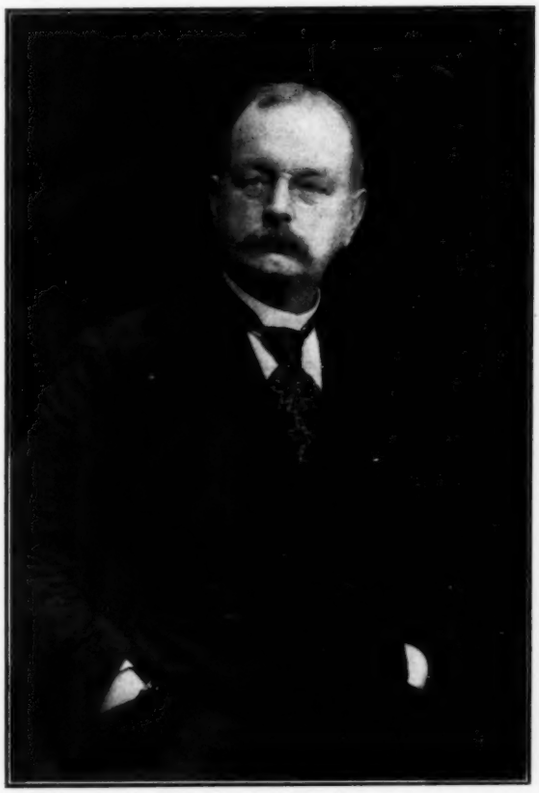
The full stenographic report of the proceedings is in the hands of the Secretary, to be published in pamphlet form and a copy sent to each member.

THE ROSTER.

Those recording their names are given below, although there were a number of gentlemen coming in the last day who failed to place their names on the roll:



EDWIN R. WEEKS,
The First Vice-President of the National Electric Light Association.



WILLIAM A. HOVEY,
The First Secretary-Treasurer of the National Electric Light Association.

NAMES OF ATTENDANTS—FEBRUARY CONVENTION, 1885.

Adams, H. C., Holmes, Booth & Haydens, New York city.
Angell, T. H., American Electric Works, Providence, R. I.
Askew, C. B., St. Paul Electric Works, St. Paul, Minn.
Avery, Albert L., Buffalo Electric Works, Buffalo, N. Y.
Badger, S. S., Badger Electric Light Co., Chicago, Ill.
Bailey, Theo. P., Chicago, Ill.
Baldwin, Sommerfield, Brush Electric Co., Baltimore, Md.
Beach, Wm. H., Olmstead Electric Light Co., Minneapolis, Minn.
Barton, E. M., Western Electric Co., Chicago.
Bell, Vernon, Western Electric Co., Minneapolis, Minn.
Boulton, W. H., Boulton Carbon Co., Cleveland, Ohio.

Bowen, Geo. S., Elgin Electric Light Co., Elgin, Ill.
Brintnell, H. L., Swift Electric Light Co., Saginaw, Mich.
Brown, Chas. A., Western Electric Co., Chicago.
Brown, Harold P., Chicago, Ill.
Buckley, W. J., Excelsior Electric Light Co., Chicago, Ill.
Bullock, M. C., Brush Electric Light Co., Chicago, Ill.
Burgett, H. W., American Electric & Illuminating Co., Boston, Mass.
Bush, W. L., Van Depoele Co., Chicago.
Carter, Geo. W., Van Depoele Co., Jackson, Mich.
Cleveland, H. M., Schuyler Electric Light Co., Hartford, Conn.
Cotter, C. A., Ansonia Brass & Copper Co., Chicago.
Crossman, Geo. L., Thomson-Houston Electric Light Co.
Curtis, C. C., Brush Company, Cleveland, Ohio.
Donaldson, Gilbert, Electric Light Co., St. Paul, Minn.
Fletcher, Geo. D., Van Depoele Co., Dixon, Ill.
Fletcher, J. R., Dayton Electric Light Co., Dayton, Ohio.
Fleisheim, Joseph, Electric Light Co., Menomonee, Mich.
Fox, E. M., E. Remington & Sons, Ilion, N. Y.
French, Chas. E., Cleveland Carbon Co., Cleveland, Ohio.
Fyfe, John C., Nee Bau Electric Light Co., Chicago, Ill.
Fishback, L. M., Parker-Russell Mfg. Co., St. Louis, Mo.
Goldthwaite, W. M., Electric Light Co., La Porte, Ind.
Goldthwaite, W. M., Electric Light Co., Adrian, Mich.
Gray, Elisha, Chicago.
Hammett, W. A., New York Safety Steam Power Co., Chicago, Ill.
Haskins, C. C., Western Electric Co., Chicago.
Hathaway, W. P., Fuller Electric Light Co., Milwaukee, Wis.
Hochhausen, W., New York.
Hovey, Wm. A., ELECTRICAL REVIEW, New York, N. Y.
Ide, A. L., Springfield, Ill.
Jacobus, D., Van Depoele Co., Crookston, Minn.
Johnson, R. M., Hyde Park, Ill.
Keasel, W. H., Willoughby, Hill & Co., Chicago.
Keim, E. T., United States Electric Light & Power Co., Dubuque, Iowa.
Knapp, W. A., Railway Telegraph Supply Company, Chicago.
Kreidler, W. A., Chicago.
Lane, A. N., Muskegon, Iowa.
Lewis, W. T., Thomson-Houston Co., Racine, Wis.
Libbey, E. D., New England Glass Co., Boston.
Locke, S. E., Schuyler Electric Light Co., Omaha, Neb.
Mills, F. M., Thomson-Houston Co., Des Moines, Iowa.
Montague, E. R., Brush Co., La Crosse, Wis.
Morrison, J. F., Brush Electric Co., Baltimore, Md.
McDonald, R. L., Jenney Electric Co., Ft. Wayne, Ind.
McDonald, R. T., Jenney Electric Co., Ft. Wayne, Ind.
McLaughlin, A. W., Holmes, Booth & Hayden, New York.
Neville, J. C., Manufacturing Electric Light Crossarms, South Bend, Ind.
O'Beirne, E. J., Star Iron Tower Co., Ft. Wayne, Ind.
Palmer, E. B., Sperry Electric Light Co., Chicago.
Parker, G. W., Parker-Russell Mfg. Co., St. Louis, Mo.
Place, Edwin, Sperry Electric Light Co., Chicago.
Plumridge, T. P., American Carbon Co., Chicago.
Powers, W. T., Grand Rapids Electric Light Co., Grand Rapids, Mich.
Price, Chas. W., ELECTRICAL REVIEW, Chicago.
Randolph, R. J., Rockford, Ill.
Reid, J. H., Electrical Supply Co., Chicago.
Richards, C. J., Racine, Wis.
Ridlon, Frank, Brush Electric Co., Boston, Mass.
Robinson, R. T., Providence, R. I.
Robinson, J. D., New England Glass Co., Chicago.
Russell, D. R., Parker-Russell Mfg. Co., St. Louis, Mo.
Simpson, J. D., Chicago.
Slack, L. W., Pittsburgh Carbon Co., Pittsburgh, Pa.
Sperry, Elmer A., Sperry Electric Light Co., Chicago.
Stanley, H. D., Bridgeport Electric Light Co., Bridgeport, Conn.
Stanwood, J. H., Badger Electric Light Co., Chicago.
Stewart, Frank, Western Electric Co., Chicago.
Stiles, Aaron K., Van Depoele Co., Chicago.
Terry, F. S., Electrical Supply Co., Chicago.
Van Depoele, C. J., Van Depoele Co., Chicago.
Wadsworth, Geo. H., Boulton Carbon Co., Cleveland, Ohio.
Walworth, W. T., Manufacturing Electric Light Crossarms, South Bend, Ind.
Warren, C. C., United States Electric Light Co., Chicago.
Webster, C. H., Chicago.
Weeks, E. R., Thomson-Houston Electric Light Co., Kansas City, Mo.
Yarborough, J. H., Nashville, Tenn.
Young, John, Western Electric Co., Chicago

It is interesting at this time to dwell a little longer on the attitude of mind of the central station men when the first convention of the National Electric Light Association was called to order.

From the official proceedings we find that first of all it was decided to leave out of consideration and discussion the relative merits of different lamps. It was pointed out that the electrical apparatus was not the only factor to success. One speaker indicated that there was a certain company using a certain system which was succeeding in making money, giving good light, increasing its business, and giving satisfaction to its customers. There was another company using precisely the same system, which was giving a poor light, losing money, losing business and being overcome by the opposition.

It appeared that in 1885 there were grave doubts on the part of those interested in an electric light and power enterprise of the profitableness of their undertakings.

Mr. Bowen upon accepting the temporary chairmanship, stated that the electric light men had just passed through a year of most trying difficulties, which he hoped they would never see again.

There was quite a tangle over the appointment of committees. Mr. Bowen was not familiar or well acquainted with a great many of those in attendance, and in fact there was not the clearest idea as to whether the purely practical or scientific and academic aspects of the industry should be given prominence.

There was a very active discussion on the relative merits of the telephone and telegraph systems. It seems that in those early days the telephone man regarded the electric light men as his natural enemy, because the telephone man had not yet learned to protect his circuits and the electric light man apparently did not think that he should.

It is refreshing to read of the position which Mr. Vail, then general manager of the Bell Telephone Company, took with respect to this matter. When Mr. Hovey was president of the Electric Light Company in Boston he visited Mr. Vail at telephone headquarters, and the latter said to him: "The Electric Light and Bell Telephone Company have come to stay, and they are going to stay, and you might say we are either going to stand together or fall together, except that the latter is not the fact. We are going to stand together and help each other." Thus, at a time when a false attitude might have retarded to a great extent the development of both of these industries, the policy of the man who today wields the greatest influence in telephone and telegraph circles laid down the fundamental principle which has worked unto success.

The subject of rates and the extent to which the electric light men could compare notes on the cost of operation gave the pioneers a good deal of concern. So strong was the objection on the part of several of those present to the making public of cost information that upon the vote of the convention the appointment of a committee to secure cost data was annulled.

In accepting the presidency of the association, Mr. Morrison said that the organization would enable the central station men to stand shoulder to shoulder to defend their rights. It would give them an opportunity of communication between each other which they should have had long before. He advocated another meeting in at least six months, and adjured those present to hold to strict account their engineers and superintendents that they might furnish every bit of information possible to be communicated to the organization.

Twenty-five Years of the National Electric Light Association.

A Commentary on the Conventions Which Have Been Held Since the Beginning of the Organization.

While a quarter of a century is but a very brief period in point of time, it so happens that with respect to the development of the electric lighting industry it represents a great deal, of a commercial nature, of what has been accomplished.

The first convention of the National Electric Light Association was called to order in February, 1885. The first report of the proceedings of this convention are published on other pages of this issue. It was early recognized that there was a great opportunity for central station men to come together and discuss those features of operation which involved problems so intricate that the mind of one man was hardly capable of solving. The National Electric Light Association has had a phenomenal growth, and it is safe to say that it has been the inspiration and very essential help to the electric lighting men during the most crucial and trying times.

CONVENTIONS OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION—1885-1910.

Date.	Presidents.	Places.
1885—February 25-26.	J. Frank Morrison.	Chicago, Ill.
1885—August 18-19-20.	J. Frank Morrison.	New York, N. Y.
1886—February 10-11-12.	J. Frank Morrison.	Baltimore, Md.
1886—August 31, September 1-2.	J. Frank Morrison.	Detroit, Mich.
1887—February 15-16-17.	J. Frank Morrison.	Philadelphia, Pa.
1887—August 9-10-11.	J. Frank Morrison.	Boston, Mass.
1888—February 21-22-23.	J. Frank Morrison.	Pittsburg, Pa.
1888—August 29-30-31.	S. A. Duncan.	New York, N. Y.
1889—February 19-20-21.	S. A. Duncan.	Chicago, Ill.
1889—August 6-7-8.	E. R. Weeks.	Niagara Falls, N. Y.
1890—February 11-12-13-14.	Marsden J. Perry.	Kansas City, Mo.
1890—August 19-20-21.	Marsden J. Perry.	Cape May, N. J.
1891—February 17-18-19.	Marsden J. Perry.	Providence, R. I.
1891—September 7-8-9.	Chas. R. Huntley.	Montreal, Can.
1892—February 23-24-25.	Chas. R. Huntley.	Buffalo, N. Y.
1892—February 28, March 1-2.	James I. Ayer.	St. Louis, Mo.
1894—February 27-28, March 1-2.	E. A. Armstrong.	Washington, D. C.
1895—February 19-20-21.	C. J. Francisco.	Cleveland, Ohio.
1896—May 5-6-7.	C. H. Wilmerding.	New York, N. Y.
1897—June 8-9-10.	Frederic Nicholls.	Niagara Falls, N. Y.
1898—June 7-8-9.	Samuel Insull.	Chicago, Ill.
1899—May 23-24-25.	A. M. Young.	New York, N. Y.
1900—May 22-23-24.	S. T. Carnes.	Chicago, Ill.
1901—May 21-22-23.	James Blake Cahoon.	Niagara Falls, N. Y.
1902—May 20-21-22.	Henry L. Doherty.	Cincinnati, Ohio.
1903—May 26-27-28.	Chas. L. Edgar.	Chicago, Ill.
1904—May 24-25-26.	Chas. L. Edgar.	Boston, Mass.
1905—June 6-7-8-9-10-11.	Ernest H. Davis.	Denver, Colo.
1906—June 5-6-7-8.	Wm. H. Blood, Jr.	Atlantic City, N. J.
1907—June 4-5-6-7.	Arthur Williams.	Washington, D. C.
1908—May 19-20-21-22.	Dudley Farrand.	Chicago, Ill.
1909—June 1 to 5.	W. C. L. Eglin.	Atlantic, N. J.
1910—May 23 to 28.	F. W. Frueauff.	St. Louis, Mo.

For some time the Association held its conventions twice a year, the sessions lasting generally about two days. The first semi-annual convention was held at New York City, August, 1885. The discussions related principally to the permanizing of the organization and the establishment of a definite line of procedure with respect to the work which would be undertaken by the Association. It was at this meeting that the following amendment to the constitution was adopted:

"Members of this Association shall be persons, firms or corporations engaged in the lighting business, to-wit, that of supplying electric lights from a central station to public or private consumers, as distinguished from such as are operating private plants or engaged in the manufacture or sale of electrical machinery, apparatus or supplies."

The subject of operating cost was brought up and received a very frank discussion instituting a decided change from the narrow attitude that characterized the previous meeting.

The subject of tower lighting received a great deal of attention, and this system was hailed as the most practical and enduring that could be secured. Taking up the cudgels for the incandescent lamp, Dr. Otto Moses presented a classical paper and pointed out the advantages of subdividing the light in certain localities, with a most interesting discussion of the manufacture and development of the incandescent lamp.

The second annual convention was held in Baltimore, in February, 1886. Dr. Otto Moses presented one of the important papers at this convention as the report of the committee on "Electricity as an Illuminant." It was pointed out that "in the conflict between gas and electricity as an illuminant there is no point in favor of gas except its cheapness, but this advantage will every day diminish, while the superior healthfulness of electric light and its greater safety against fire, and the ease with which it lends itself to decoration, must force its acceptance by the public long before the equality of cost is reached."

John W. Beane presented a paper entitled "The History of the Progress of Electric Lighting," and a classical paper was presented by T. C. Martin on the "History and Progress of Electricity As Applied to Motors."

At this meeting there was a discussion of the proper pronunciation of the word "dynamo," the consensus of opinion being that the pronunciation be adopted, not by direct action of the convention, but by consent, placing the emphasis on the first syllable—"dy'-namo."

A paper entitled "Operating Expenses" was presented by Edwin R. Weeks of Kansas City. This was probably the first comprehensive treatment that this subject had received, but the discussion elicited was very slight. Dr. Moses again gave a comprehensive review of the development of the incandescent lamp. It was at this meeting that the question of the relation of electric lighting to insurance was first brought up. The report on this subject was voluminous and indicated the condition of mind of the insurance companies as to the fire hazard of the electrical conductor. The action of the underwriters in advancing the rates of insurance upon electric light plants led to the discussion of the formation of a mutual electric light insurance company, the plan of organization of which was endorsed by the association, and motion was made to appoint a committee to promote such an organization. It was pointed out that such an organization should be carried out entirely outside of the National Electric Light Association, and after considerable discussion a resolution was adopted simply endorsing the plan of organization.

The fourth convention, which was the second annual convention of the association was held at Detroit, Mich., the last day of August and the first two days of September, 1886. At this meeting a resolution was passed approving the new standard English wire gauge which had been officially adopted by the National Telephone Association. The committee on standard gauge was continued with instructions to confer with other associations similarly interested with a view to the legalizing by Congress of a standard gauge for guidance in the preparation and enforcement of contracts. There was much protest against the enforcement of electrical subways.

The paper by T. C. Martin on the "Operation of Motors from Electric

Light and Power Stations" brought out the fact that there were more than one hundred electric light companies which had added the words "and power" to their titles. This paper called attention to the adoption of motors by the Baltimore Daft Electric Street Railway, the Daft system at Revere Beach, Mass., and Los Angeles, Cal., and the considerable adoption of the VanDepole system in a number of cities. The Bentley-Knight system had also been tried out successfully at Cleveland, and Frank J. Sprague was just introducing his system of motors for multiple operation. This appeared to be the day of electric motors and a great deal of discussion at the convention was given up to this subject.

The convention held in Chicago, in 1885, resulted in fifty-three companies being represented. The convention held in Philadelphia in February, 1887, mustered 159 representative companies.

At this meeting the question of a standard wire gauge was taken up and it appeared that although the association had approved of the adoption of the British standard gauge, none of the members had carried this out in practice. It was finally decided to continue this committee to report at the next meeting.

The September, 1886, convention brought to the front the growing popularity of the incandescent lamp. At the beginning of 1886 about sixty arc lighting companies were operating incandescents as a regular and large part of their business and by September the number had about doubled. In a number of instances the old arc company had formed a new organization to handle incandescent lighting.

The Philadelphia convention in 1887 brought out considerable discussion with respect to the use of incandescent lamps on arc circuits and the running of motors and lights on the same circuit. Dr. Moses electrified the convention with his description of the new alternating current system which was worked out at Pittsburg, under the title "Electric Distribution of Energy by Means of Secondary Generators." It was a moment of intense excitement when he predicted that the day would come when electricity would be distributed at potentials of from 20,000 to 30,000 volts.

The Boston convention of August, 1887, found a more favorable conception and reception for the idea of alternating-current distribution. The matter of higher engineering knowledge was beginning to assert itself, and the paper on "Electrical Education," by E. R. Weeks elicited some very favorable discussion.

The paper entitled "The Electric Lighting Outfits of the New Cruisers," by Lieutenant J. B. Murdock, indicated the growing utility of electric service on shipboard. An interesting feature of this convention was the report of the committee of the Association of Electric Light Companies for making a protest against exorbitant prices of carbon. The committee reported that owing to a collapse of the carbon combination it was not deemed advisable to take further action to establish a manufactory or to concentrate a large number of contracts for carbon. There was a great discussion over the amendment of the constitution providing for the election of the president and vice-president and making it impossible for the executive officer to be elected for two consecutive years. A resolution was passed approving the use of the metric system and the giving of the actual diameter in ordering wire. There was a revival of interest in the storage battery for lighting, power, railway and marine service.

The Pittsburg convention in February, 1888, marked the establishment of goodly-sized figures in the industry. There were over 3,000 isolated plants and over 1,000 central stations. It was estimated that there were 175,000 arc lights and over 1,750,000 incandescents in service. The membership had grown to 168. O. B. Shallenberger and T. Carpenter Smith read memorable papers on alternating-current distribution. This meeting saw the introduction of higher mathematics into the technical papers by the contribution of Dr. Liebig on electric motors. There was a great debate over the amendment of the constitution providing for the election of the president and vice-president by ballot. It was also voted to pay the secretary-treasurer a salary of $900 per annum, and a glowing tribute was paid to retiring president Morrison.

The New York convention, in August, 1888, established the practice of appointing a committee to consider and report on the president's address. S. S. Wheeler's paper on "Overhead and Underground Wires in New York" indicated a growing interest in underground construction, and showed an approval of the drawn-in system with frequent manholes. An effort to drop the word "Light" from the title of the association and give it an international characterization was defeated. The annual dues were raised to $20, and several members spoke very strongly on the advisability of according membership in the association to anyone connected with the electrical business. It was decided to establish permanent headquarters in New York city and to place an expert electrical engineer in charge as secretary.

The ninth convention was held in the Exposition Building, Chicago, in February, 1889. Largely through the efforts of B. E. Sunny there was a comprehensive exhibit of electrical apparatus. There were more frequent reports by standing committees, underground conductors and insulated cables receiving much attention. The appointment of Allan V. Garrat, of Boston, as secretary was announced, and the dread question of municipal ownership intruded itself upon the convention.

Niagara Falls, N. Y., was the scene of the tenth convention in August, 1889. At that time it was stated that in the electric light and power, street railway, and telephone and telegraph interests there was an investment of over $275,000,000. At that time there was quite a furor over the execution of Kemmler by means of electricity, and many impassioned addresses were made upon the floor of the convention denouncing this mode of execution.

The convention of February, 1890, held in Kansas City, was important in that the question of mutual insurance was pretty definitely settled, attention was drawn to systems of central station accounting, the matter of census data was discussed and F. J. Sprague read his classic paper on "Application of Electricity to Street Railways." A committee was appointed to confer with the national insurance companies with a view to establishing standard rules for electrical construction and operation.

The "Proper Classification of the Lighting Power of Incandescent Lamps," by Dr. Louis Bell, and "The Proper Basis for Determining Electric Motor Rates," by H. L. Lufkin, were among the leading items of the 1890 convention held in August, at Cape May, N. J. "Standards of Economy in Generation of Power," by H. M. Swetland, of New York, gave the convention a new point of view and there was a great debate over the proposition to effect membership changes in the constitution.

The thirteenth convention, held at Providence, R. I., in February, 1901, brought out Edward Weston's paper on "Electrical Measuring Instruments," together with a widely varied series of articles on other electrical topics.

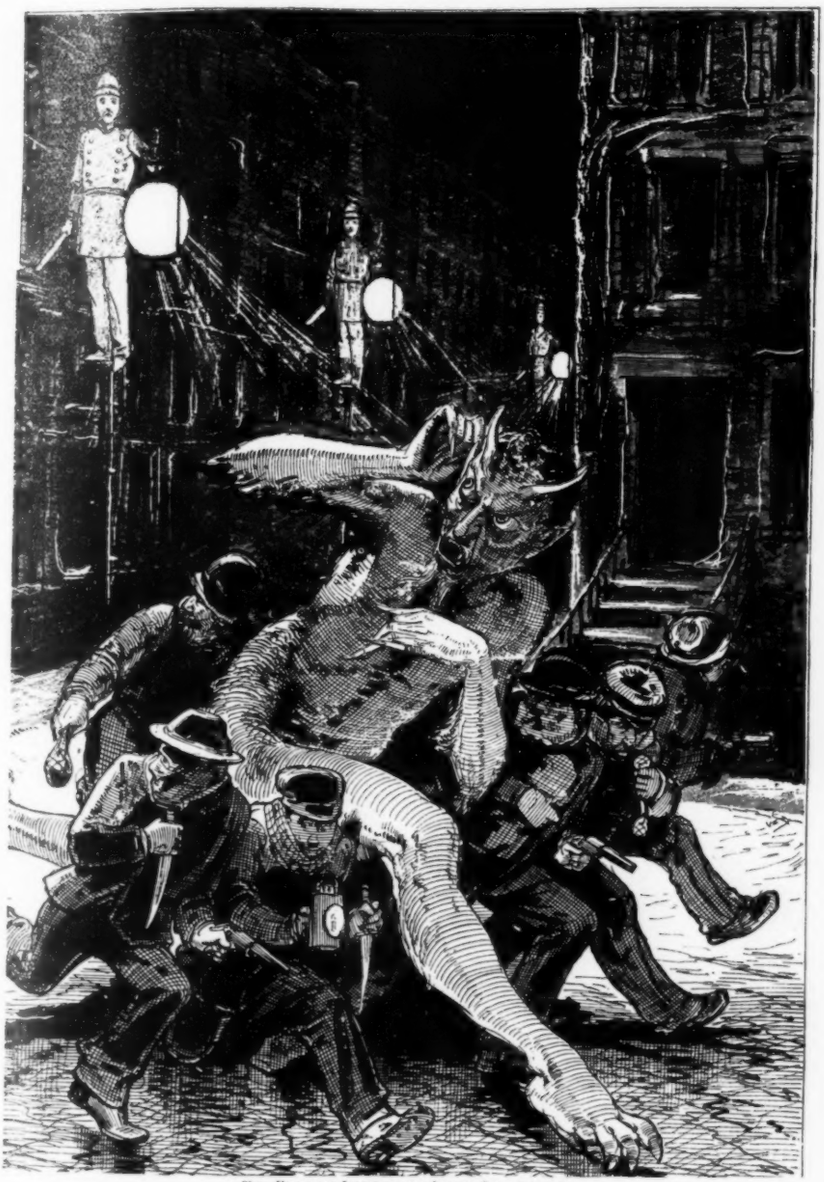
The international character of the association was exemplified at the fourteenth convention which was held in Montreal, Canada, in September, 1891. Water-power plants, uniformity in methods of keeping central station accounts, and electrical census statistics received prominent attention. This covention also inaugurated the idea of a coherent exhibit as a prominent feature of the meetings.

The fifteenth convention, held in Buffalo, February, 1892, brought out the paper by L. B. Stillwell and a great discussion by William Stanley and Elihu Thomson on transformers. "Overhead Construction," by E. F. Peck, and "Municipal Franchises for Quasi-Public Corporations," by A. R. Foote, elicited the greater part of the discussion. This convention established the executive sessions of the association, and brought about the decision to have no summer meeting.

The sixteenth convention was held at St. Louis, February, 1893. Stillwell again brought forth an interesting and important contribution on water power plants and Calvert Townley contributed a notable addition in his paper entitled "The Incandescent Lamp from a Commercial Standpoint."

Washington, D. C., was the scene of the seventeenth convention, held in March, 1894. There was a great debate on the rating of arc lamps which resulted in the following resolution: "That in the opinion of this convention what is ordinarily known as a 2,000-candlepower arc lamp is one requiring on the average 450 watts for its maintenance, the measurement being made at the lamp terminals, where no sensible resistance is included in series with the arc. In case such resistance is used, it must be excluded in the measurement of the voltage." The rate question came in for a very brief discussion upon the reading of the paper entitled "Meters versus Flat Rates," by F. Nicholls.

The eighteenth convention, held at Cleveland, February, 1895, brought out the paper by E. J. Houston and A. E. Kennelly on "A New Method of Measuring Illumination." Arc lamps and rating of arc lamps came in for a goodly discussion and the time of meeting was changed from February to May or June.



THE ELECTRIC LIGHT AS AN AID TO CIVILIZATION.

THE ARC LAMP IN 1885.
From an Old Woodcut in the ELECTRICAL REVIEW, March 7, 1885. The Powers of Evil are Fleeing before the Light of Civilization.

In May, 1896, the nineteenth convention was held at New York. This brought out a comprehensive report of the committee on standard rules on electrical construction and operation, and a report on the standard candle.

The twentieth convention, held at Niagara Falls, N. Y., in June, 1897, brought out a remarkable paper by J. B. Cahoon, entitled "The Establishment of a Base Price for Current." Theft of current came in for much attention and Arthur Wright's great paper on "Profitable Extension of Electricity Supply Systems" laid the foundation for future discussion of the rate question.

The twenty-first convention held in Chicago, June, 1898, was notable for the discussion to the question of the relation of the public utility company to the public through Alex Dow's paper on "Public Lighting in Relation to Public Ownership and Operation." The growing importance of the work of the executive session was realized and important matters were taken up at this time.

The twenty-second convention was held at New York, May, 1899. Dr. E. W. Goldsborough followed up his interesting paper of the year before with another on transformers. The committee on the photometric value of arc lamps presented a valuable report and Paul Spencer contributed an important paper on "Standard Specifications for Electrical Apparatus."

"Exhaust Steam for Heating," and the paper entitled "Operating Economies in Central Station Practice," by W. L. Abbott, indicated new lines of thought at the twenty-third convention held in Chicago, May, 1900, and the progress report on the committee on standard specifications for electrical apparatus was a valuable document. Uniform accounting came to the fore and an important contribution was made by William Lispenard Robb on series enclosed arc lighting for street lighting service. The committee on grounded circuits began its perennial labors. The automobile as a source for revenue for central stations by Elmer A. Sperry was a forerunner of a matter which is receiving a great deal of consideration today, and the paper by Henry L. Doherty on "Equitable, Uniform and Competitive Rates," laid the foundation for an intelligent discussion of the readiness to serve charge.

The twenty-fourth convention was held at Niagara Falls, N. Y., May, 1901. The committee on uniform accounting presented a very comprehensive report, and steam heating and storage batteries came in for a lengthy discussion.

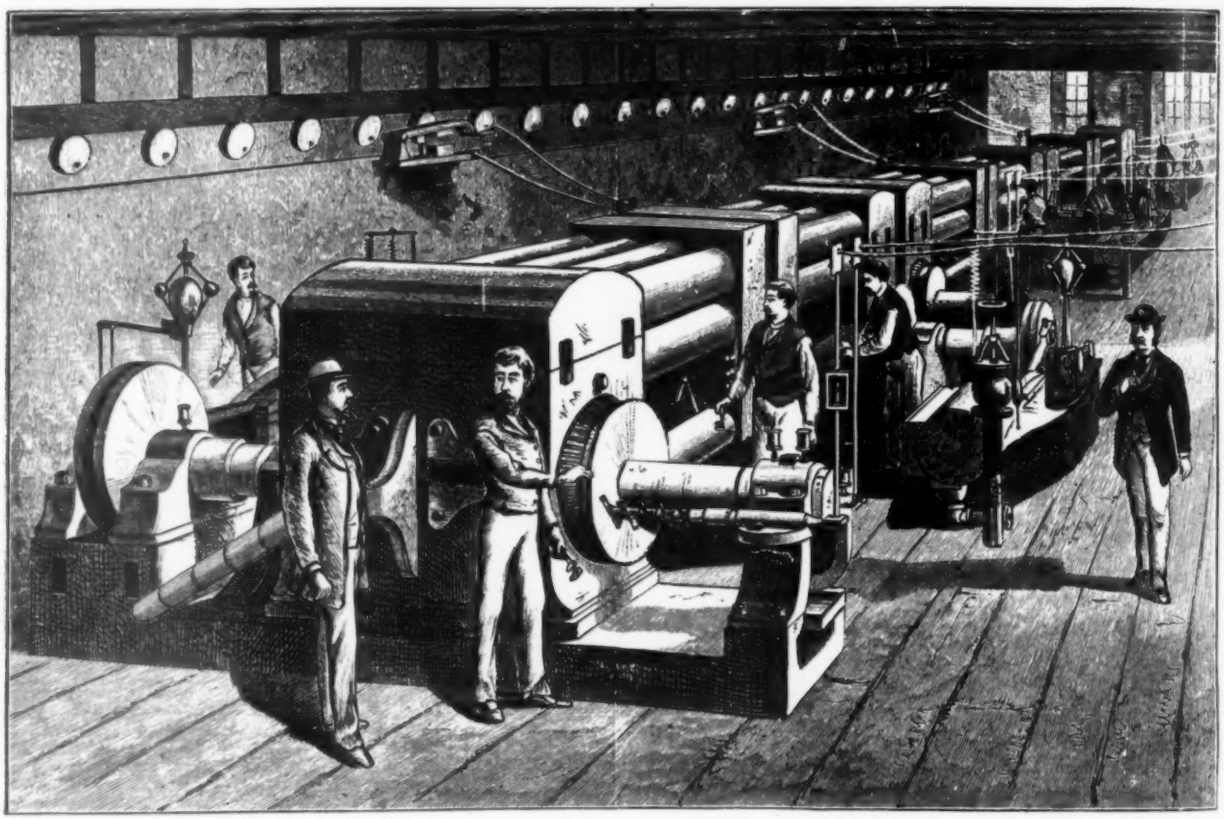
The twenty-fifth convention, held at Cincinnati, May, 1902, brought about an amendment of the constitution and change in the active membership dues. The appointment of J. B. Cahoon as secretary was announced and resolutions commending the services of the re-

tiring secretary, George F. Porter, were passed. There was considerable discussion over the paper entitled "What Efficiency Lamps Should Be Used and How May This Efficiency Be Determined for Any Particular Station." At this time what has proved to be one of the most valuable papers ever contributed to the literature of the subject was presented by C. P. Matthews in the report of the "Committee for Investigating the Photometric Values of Arc Lamps." Protection of long-distance lines and rates were discussed at length and the Question Box established.

The twenty-sixth convention, held in Chicago, May, 1903, initiated the "Progress Reports," by T. C. Martin. E. Holmes. The internal combustion engine was given prominent attention and important changes made in the constitution with regard to the classification of membership.

The twenty-eighth convention, held in June, 1905, in Denver and Colorado Springs, will be remembered for the excess of hospitality and entertainment accorded the visitors. This convention saw the introduction of the tantalum incandescent lamp and the beginning of the voluminous reports on steam turbines by W. C. L. Eglin. J. Robert Crouse launched his "Cooperative Plan of the Lamp Manufacturers for Business Promotion," and James I. Ayer presented a notable paper on "Progress in Electric Heating." Rates and success. Methods of getting new business and profitable cooperation were leading topics for discussion. "Municipal Ownership," by E. W. Burdett, put a quietus on the aspirations of a good many of the ill-advised and some very important measures looking to the future conduct of the organization were discussed at the executive session.

The thirtieth convention was held at Washington, D. C., June, 1907. This convention accentuated the intense development of the association's work. There were many important matters brought up, notably the developments in public policy, the reports on uniform systems of accounting, the report of the committee on protetion from lightning, on the gas engine, on steam turbine de-



AN EARLY CENTRAL STATION.

The first Edison Station, at Pearl Street, New York.—From an old woodcut in the *Scientific American*, August 26, 1882.

"Office Methods and Accounting" and "The Young Engineer and the Electric Light Plant," took up a deal of time. "Tactful Relations of Customers," by J. W. Ferguson, and "Relations with Employees," by Arthur Williams, showed the changing tendency of the corporation in its relation to the public and its treatment of labor. Decorative lighting came in for a share of attention and theft of current and lost and unaccounted for current was also discussed.

The twenty-seventh convention, Boston, Mass., 1904, brought out the "Luminous or Flaming Arcs," by Welles costs, and the Nernst lamp came in for a large share of the discussion.

The twenty-ninth convention was held at Atlantic City, June, 1906. Illumination and the newer illuminants came in for a good share of the discussion, the papers by W. S. Barstow on "The Mercury Arc Rectifier with Magnetite Lamps for Street Illumination," by L. B. Marks on the "Flaming Carbon Arc Lamp" were prominent in this direction. This convention paved the way for a new element in the discussions of the association and introduced the recognition of the commercial man as an important factor in central station velopments and under the heading of "Commercial or New Business Day," there was a very extended discussion accorded to the new ideas in business-getting and central station advertising.

The thirty-first convention was held in Chicago, May, 1908, and the thirty-second convention at Atlantic City, June, 1909. The Chicago convention introduced the parallel session when the commercial program was made a leading consideration, this development being enlarged upon at the session at Atlantic City, when special session were devoted to accounting. Special work was also inaugurated at the Chicago

convention, affecting classification of membership, the resulting increase in members being beyond the expectations of those inaugurating this movement.

CHANGES OF A QUARTER CENTURY.

Twenty-five years ago the electrical industry was just emerging from its swaddling clothes. The companies in the manufacturing and supply business at that time were not very numerous as compared with the present day, and only a few of them are now in existence under the same name.

The advertising columns of the ELECTRICAL REVIEW twenty-five years ago carried the announcements of companies who are in business today under the same name, as follows:

Western Electric Company.
J. H. Bunnell & Company.
Buckeye Engine Company.
Westinghouse Machine Company.
Mitchell-Vance Company.
American Electrical Works.
Leelanche Battery Company.
Bishop Gutta Percha Works.
Alfred F. Moore.
Partrick, Carter & Wilkins.
Phosphor-Bronze Smelting Company.
Kerite Company.
Ansonia Brass & Copper Company.
Holmes, Booth & Haydens.
Bridgeport Brass Company.
Okonite Company.
New England Butt Company.
National Carbon Company.
James Leffel & Company.
Standard Underground Cable Company.
Shultz Belting Company.
John A. Roebling's Sons Company.
Phoenix Glass Company.
Baker & Company.
Charles A. Schieren & Company.

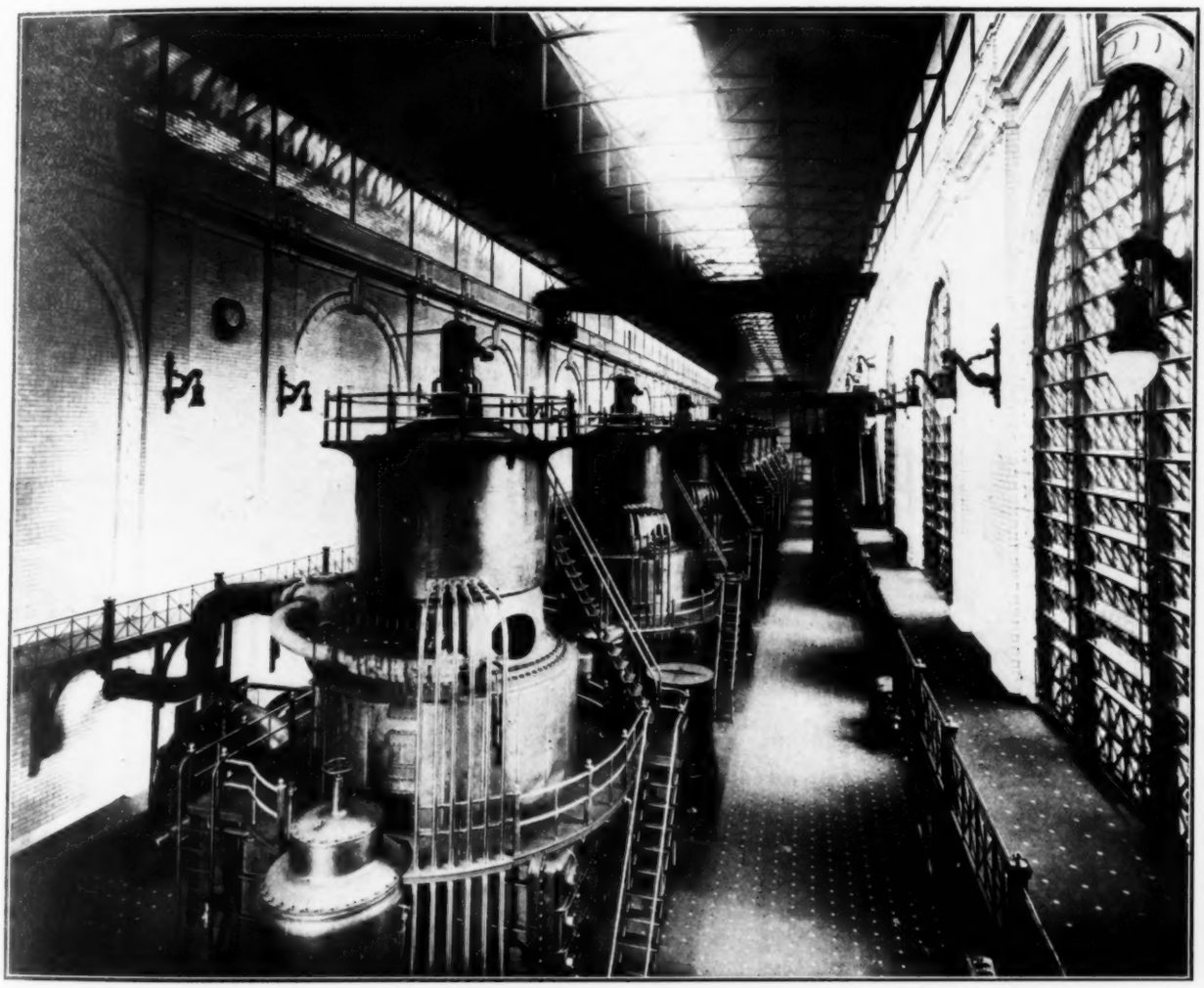
Among other announcements were those of the American Bell Telephone Company, now controlled by the American Telephone and Telegraph Company; the Thomson-Houston Electric Company and the Brush Electric Company, now of the General Electric Company; the United States Electric Lighting Company, manufacturing Weston dynamos and motors, and Weston arc and incandescent lamps, now merged with the Westinghouse Electric and Manufacturing Company.

The personnel of the electrical field has changed greatly in twenty-five years. Among those active in electrical circles twenty-five years ago who are still engaged in various branches of electrical work, and whose names occur readily to the writer of these lines, are the following-named persons:

E. G. Acheson.

C. O. Baker, Enos M. Barton, H. M. Byllesby, Belvidere Brooks, W. R. Brixey, T. P. Bailey, Harold P. Brown, Charles A. Brown, Edgar C. Bradley, W. H. Baker, Horatio J. Brewer, W. H. Bristol, F. B. Badt, C. R. Bangs, George H. Benjamin, E. G. Bernard, C. S. Bradley, John I. Beggs.

C. A. Coffin, W. L. Candee, J. J. Carty, J. B. Crouse, Col. R. C. Clowry, W. J. Clark, E. A. Colby, Robert E. Cory, F. B. Crocker, George Cutter.



A MODERN CENTRAL STATION.

The Fisk Street Station of the Commonwealth Edison Company, Chicago, Ill., Represents the Most Up-to-Date Practice in Central-Station Development.

B. M. Downs Dr. Louis Duncan, A. J. DeCamp, Charles E. Dustin, Thomas B. Doolittle, L. N. Downs, William R. Driver, Alex. Dow.

Thomas A. Edison, Charles L. Edgar, James English.

H. N. Fenner, Stephen D. Field.

E. J. Hall, D. C. Hemingray, W. J. Hammer, A. S. Hibbard, Gerald Hart, James W. Howell, Henry Hine, George W. Hebard, George A. Hamilton.

Samuel Insull.

W. A. Jackson.

J. N. Keller, Frank B. Knight, E. R. Knowles, P. O. Keilholtz.

Thomas D. Lockwood, J. W. Lieb, J. R. Lovejoy, H. Ward Leonard.

George A. McKinlock, George T. Manson, W. H. McKinlock, J. F. Morrison, T. C. Martin, Alfred F. Moore, F. S. Marr.

A. H. Patterson, J. D. Packard, Charles W. Price, Ralph W. Pope, E. F. Peck, Henry W. Pope, George W. Patterson.

F. W. Roebling, Henry A. Reed, Frank Ridlon, C. R. Remington, Frank B. Rae, E. W. Rice, Jr., A. L. Rohrer.

Bernard E. Sunny, F. J. Sprague, A. L. Salt, Elmer A. Sperry, H. D. Stanley, Gen. Thomas A. Sherwin, W. D. Sargent, F. A. Scheffler, C. E. Scribner, Charles Selden, Col. Charles F. Sise, William Stanley, C. A. Schieren.

Elihu Thomson, H. B. Thayer, F. S. Terry, B. G. Tremaine, Charles A. Terry.

Theodore N. Vail, C. R. Vincent.

George Westinghouse, Edward Weston, E. R. Weeks, James J. Wood, S. S. Wheeler, George G. Ward, George L. Wiley, H. H. Westinghouse, C. H. Wilson.

Southern Power Mortgage.

The Southern Power Company, through its local counsel, has filed in the office of the register of Mense conveyance at Spartanburg, S. C., a $10,000,000 mortgage covering a recent bond issue.

The mortgage is given to the Farmers' Loan and Trust Company, of New York, and is dated March 1, 1910.

The Southern Power Company owns extensive water powers in the Piedmont section and is promoting an electric line from Anderson, S. C., to Charlotte, N. C., by way of Spartanburg and Greenville.

The Central & South American Telegraph Company's operating revenue for quarter to March 31 (partly estimated) was $440,500; net $273,500; interest accrued on deposits, $2,500. Dividends of $143,565 were paid in April, leaving estimated addition to surplus of $132,435.

Empire State Gas and Electric Association.

A meeting of the Empire State Gas and Electric Association was held on May 11, Syracuse, N. Y., in the assembly room of the Yates Hotel. There were about fifty members present. As the morning was to be devoted to discussion of gas questions, a number of the electrical men took the opportunity of visiting the plant of the Syracuse Lighting Company under the guidance of a number of the company's representatives.

When the morning meeting was called to order by M. J. Brayton, vice-president of the association, Mr. DeLong extended a very cordial invitation to all of the delegates to be his guests at luncheon at the Century Club.

After this luncheon, which was an extremely pleasant affair, the delegates returned to the hotel and during the afternoon many matters of general interest to both the gas and electric men were discussed informally. There were no papers read and the meeting was open to anyone to bring up such matters as were of interest, the result being that many interesting things were brought out which will doubtless be of considerable assistance to those who were present.

These meetings will be continued from time to time in different parts of the state, it being felt that much benefit is derived, not only from the discussion itself, but also through affording an opportunity to the representatives of the different companies to become acquainted and to exchange ideas.

At the end of the meeting a vote of thanks to the Syracuse company for its entertainment was proposed and unanimously carried by a standing vote.

Tenders for Canadian Hydroelectric Plant.

Vice-Consul-General James J. McBride, of Winnipeg, reports that the town of Minnedosa, Manitoba, is preparing to call for tenders for the construction of a hydroelectric power plant. The power at Minnedosa will be developed from the Little Saskatchewan River, the plant being situated within the town so that there will be no expense in the way of constructing transformers or in transmission. The available head is twenty-five feet and water storage is provided at Clear Lake, giving a steady supply the year through. The first installation will be of about fifty horsepower and as the demand increases this may be doubled. The plant though small, according to present-day standards, is intended to be one of the most complete in western Canada. An earth dam will control the water level, the surplus to be taken care of by an overflow dam. One generator will supply 450 horsepower and an exciter unit of fifty horsepower will be installed. The current may be delivered direct to the consumer, the regulation of the voltage being by pole transformers if desired. For further details application should be made to the mayor of Minnedosa.

Northwestern Telegraph Company Sold.

At a meeting of the stockholders of the Northwestern Telegraph Company, Kenosha, Wis., owner of many lines operated by the Western Union Telegraph Company in Wisconsin and Minnesota control of the company formally passed into the hands of financiers of Hartford, Conn.

A majority of the stock, amounting to nearly $4,000, was voted by Francis R. Cooley, of Hartford, and the old directors gave up their places on the board to Francis R. Cooley, Charles P. Cooley, Jonathan B. Bruce, Lyman B. Brainard, Arthur L. Shipman, Arthur R. Bradley and Henry M. Sperry, all of Hartford.

Chicago Electric Club.

Good citizenship was chosen as the subject of an address delivered before the members of the Chicago Electric Club at their regular weekly meeting on Wednesday, May 11, by John P. McGoorty, Chicago.

Mr. McGoorty spoke of the necessity of voting and appealed to the members for more active interest in public matters. He said that if this is to be a government of the people they must give some little attention to public affairs. He spoke of the importance of investigating the characters of public servants and laid particular stress on the legislators.

More Side Door Trains in New York.

The Interborough Rapid Transit Company has notified the Public Service Commission that it has twenty-seven side-door trains in operation the past few months.

Commission News From New York.

The Public Service Commission, Second District, has received a petition from the Economic Power and Construction Company and Geneva-Seneca Electric Company for consent of the commission to the transfer of the franchises, works and system of the Economic Power and Construction Company in the city of Geneva to the Geneva-Seneca Electric Company. There is now pending before the commission a complaint on the part of the Geneva-Seneca Electric Company that the Economic power and Construction Company is unlawfully exercising franchises in the city of Geneva.

The Economic company commenced doing business and believed it had a right to act under its act of incorporation and perform the services of an electric company in the city of Geneva without the consent of the municipal authorities or the commission until the Court of Appeals last year decided that it did not possess such rights. It then secured a franchise from the city of Geneva and applied to the commission for permission to exercise its franchise. The application was opposed by the Geneva-Seneca Electric Company, which is engaged in furnishing electric current in that city. It is stated that negotiations have resulted in an agreement for the Economic Power and Construction Company to dispose of its property to the Geneva-Seneca Electric Company in view of the fact that the city of Geneva has not sufficient population to justify the existence of two such plants in that city. The application states that the proposed arrangement for combination of the properties will result in a saving of operating expenses of $20,000 a year in the operation of the combined properties, including the steam heating plant. It is proposed to pay to the Economic Company $103,000 for its property, works, plant and franchises. Sufficient bonds to effect the purchase are also asked to be authorized.

The commission is asked to make an order directing its counsel to commence proper and appropriate proceedings against the New York, New Haven & Hartford in the name of the commission for the purpose of preventing either by mandamus or injunction the going into effect of certain higher rates and charges and the collection of these rates on the ground that the railroad corporation is threatening and about to demand unjust and unreasonable rates and charges contrary to and in violation of law.

The complaint asks if the commission so desires, that preliminary to the making of this order a hearing be accorded the complainants.

Electric Power in the Gold Mines at Johannesburg, South Africa.

The region producing at the present time the greatest quantity of gold is the Witwatersrand, which extends through a distance of 106 kilometres and in the center of which the city of Johannesburg is situated. Gold-bearing ore valued at more than ten million dollars is extracted every month from hundreds of shafts. The number of people employed in the mines is estimated at 100,000, and the machinery used requires for its operation more than 200,000 horsepower. In view of the great value of the metal, quickness has so far been the principal consideration in its extraction, and in the installation of machinery momentary rather than possible future requirements have been the deciding factor. But as, since the conclusion of the Boer War, orderly conditions have again prevailed and an exact examination of the gold-bearing region has shown that it will be productive at the present rate for about fifty years, and in some places for one hundred years, a systematic introduction of the latest extracting machinery and methods has been begun. On account of the almost exclusive employment of American engineers, American influence is the greatest, and during the last two years the introduction of electrical machinery has progressed with the same rapidity that distinguished the development of the gold industry itself.

The location of the mines, which extend almost in a straight line one after another, as well as the load conditions of the various machines used, make the centralization of the power requirements appear obvious. In view of the uninterrupted operation of the different machinery a load coefficient of seventy-five to eighty per cent may be attained without difficulty. The character of the ore necessitates the use of stamping mills, and according to these the power requirement is generally calculated, the estimate being eleven horsepower for each mill; but there is a growing tendency to employ larger mills. The stamping mills work uninterruptedly during the whole year and twenty-four hours a day; there are in use mine hoists requiring from 400 to 1,000 horsepower for their operation; the air compressors employed have capacities of 262 to 525 cubic metres at a pressure of six atmospheres; the aerial cable and other conveyors are subject to the usual varying load conditions. The reason that the electric drive is not employed more extensively is more of a financial than technical nature. The 7,000-horsepower station begun by the Siemens & Halske Company in 1895 did not take the expected development on account of the Boer War, and the proposal of utilizing the Victoria Falls made a few years ago and transmitting the electric power to Johannesburg was not realized, as the company organized for this purpose, the Victoria Falls Power Company, did not succeed in obtaining contracts for more than 20,000 kilowatts in the mines. This was not sufficient to guarantee efficient operation on account of the high cost of the installation and long transmission line, the distance between Johannesburg and the Falls in a straight line being about 1,120 kilometres. The possibility of transmitting power to this long distance was widely discussed in the technical press, and experts consulted by the company considered that it was practicable by the employment of the Thury direct current system with a tension of 160,000 volts.

The plant erected by the Siemens & Halske Company near Brackpan has been increased by 6,000 kilowatts, and a new 12,000-kilowatt plant was built near Simmerpan. The latter was completed in the spring of 1909, while the former has been in operation since 1907. The power of these two stations is transmitted to the various gold mines, and they constitute the first introduction of electrical energy there. Recently, after long negotiations, the various concerns have come to an understanding, since the largest mining company, which so far had resisted the introduction of electric power, has concluded to adopt this motive power in all its mines. And therefore a new concern, the Rand Mines Power Company, which is a sub-company of the Victoria Falls Power Company, has been formed, and the erection of a 90,000-kilowatt station is contemplated. This development should open up a good field for exploitation to the electrical industry.

The International Airbrake Association Holds Convention at Indianapolis.

The seventeenth annual convention of the International Airbrake Association was held in Indianapolis recently. Nearly 500 members were present and were attentive to the work of the convention. The membership includes experts, manufacturers, railroad supply men, railroad instructors and technical men who have given time and study to the work of perfecting the airbrake.

A number of interesting papers were read and thoroughly discussed. F. L. Burton, of Jersey City, read an instructive paper on "Stopping Interurban and Steam Line Trains by the Use of Emergency Airbrakes." This paper was regarded as very instructive to the railroad men present. A stereopticon lecture by M. F. Turner, engineer in the Westinghouse factory, was listened to with marked attention. The chief topic, and the one that brought out the greatest diversity of ideas was "The Best Method of Instructing Enginemen and Motormen in the Use and Manipulation of the Airbrake." S.

McAdoo Tube Granted Time Extension.

The New York Public Service Commission has granted an extension of time to the Hudson & Manhattan Railroad Company for completing its tunnel in Sixth Avenue as far as Twenty-third Street, New York City. The time expires June 15 and the extension is for one year. The same conditions apply to the spur on Ninth Street from Sixth to Fourth Avenues.

The company has also filed the consent of property owners along the proposed route from Thirty-third Street to the Grand Central station. Should the commission approve of the consent filed, work would have to begin within six months and be completed in three years.

Transatlantic Wireless Working Well.

Mr. Marconi has completed the reconstruction of the wireless station at Glace Bay. He reports the wireless transatlantic service from Glace Bay to Clifden in complete and successful operation.

Interurban Ruling in Ohio.

The Supreme Court of Ohio on May 10 last held that interurban railroads are legally bound to keep their rights-of-way fenced.

Public Service Commissions.

Within the last few years an element has been introduced into the life of the electric lighting industry which bids fair to become, and as a matter of fact it has become, an important factor in our methods of doing business.

Ten years ago there was a militant agitation for municipal ownership of public utilities, and this having spent its force and resulted in a desultory dropping off of the most prominent of those endorsing this idea, the question of legislative control of public utility corporations took firm root, and, the apparent satisfaction on the part of the public over the rulings of the Massachusetts Gas and Electricity Commission giving some distinction to the idea, it became the part of political endeavor to swing into public favor by means of party platforms embracing this idea.

The establishment of the New York Public Service Commission and the Wisconsin commission are historical. The reasons for or against the establishment of these commissions have been reiterated time and time again and it is outside the scope of this sketch to dwell with any detail upon this phase of the question. All that will be attempted here will be to make a rapid summary of the extent to which the public service commission idea has grown and to indicate graphically, if possible, those states in which public service commissions have been established to hold sway over public utility corporations, particularly those engaged in the supplying of electrical energy to private consumers.

The Railroad Commission of Alabama has supervision over railroads, express, steamboat and telephone companies. There is no public service commission, as it is generally understood today, and this condition also holds with the territory of Arizona and with Arkansas, California, Colorado, Connecticut, Delaware, Florida, Georgia and Idaho.

Illinois has no public service commission similar to that of New York State, but the tendency is in this direction. A bill for that purpose was introduced in the last general assembly of the State of Illinois, but failed to pass.

No public service commission exists in Indiana, while in Iowa there is a state board of control, which has supervision over the state institutions, with the exception of the educational institutions, and also a railway commission.

Kansas and Kentucky have no public service commission, while Louisiana has a state railroad commission, which has supervision over railroads, sleeping cars, telephone and telegraph corporations. The matter of public service commissions received some attention from the last legislation of the State of Maine, but no action was taken.

Maryland has just passed a public utilities bill providing for the appointment of three commissioners who will have jurisdiction over the entire state.

Massachusetts, of course, has its Gas and Electric Light Commission, and the Public Domain Commission of Michigan has similar powers.

There is a State Railroad and Warehouse Commission in Minnesota, and a Railroad Commission in Mississippi, but these do not have the extensive powers of the commissions to which we are here referring.

Missouri has no public service commission, the power to regulate rates for public service corporations being delegated to local officials. However, in an address before the Missouri Electric, Gas, Street Railway and Water Works Association as recently as April 16, Gov. Hadley declared he would recommend to the next general assembly the enactment of a law creating a state commission for the regulation for public utilities. Such a law was recommended last winter and the House passed the bill, but it was killed in the Senate.

Montana has no public service commission, while Nebraska has a Railway Commission that has to some extent supervision over public service corporations, but its power is somewhat limited.

Nevada has no public service commission, nor has New Hampshire, although the latter has the oldest railroad commission in the history of the country.

New Jersey has recently changed the name and enlarged the powers of its State Railroad Commission by extending its jurisdiction to public utility corporations without rate-making powers. The Governor of New Jersey contends that there are two serious defects in the bill as approved. One is the absence of the rate-making power, which he considers essential. The other is that the law does not give the commission proper authority to enforce its orders. He recommends that these two suggestions be embodied in a new bill to be passed by the Legislature.

The territory of New Mexico has no public service commission.

New York has two Public Service Commissions, that for the First District, embracing all corporations except telephone and telegraph companies in Greater New York, and that for the Second District, the rest of the state. A bill has been introduced in the Assembly extending the powers to telephone and telegraph companies.

North Carolina has no public service commission, but the corporation commission has some oversight over railroads and other corporations.

North Dakota has no public service commission, while Oklahoma has a clause in its constitution providing for the creation and election of a State Corporation Commission of three members, whose supervision is over all public service corporations such as railroads in the state.

Ohio has a bill pending.

Oregon has no public service commission.

Pennsylvania has no public service commission similar to that of New York State. The functions of a public service commission are divided among several departments. The Railway Bureau of the Department of Internal Affairs and the State Railroad Commission are charged with certain duties and powers over the operation of steam and electrical railways. All charters for steam and electric railways, water companies and other corporations are granted by the secretary of the commonwealth with the approval of the Governor.

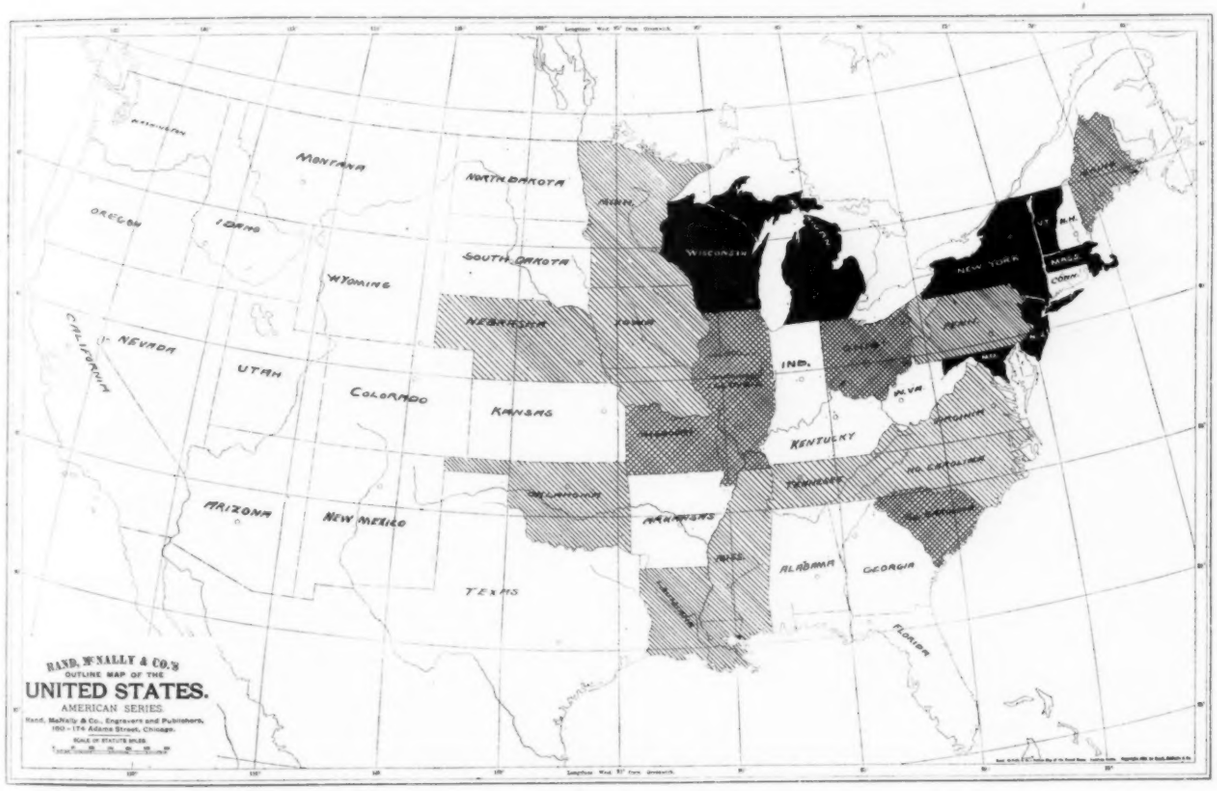
There is no public service commission in Rhode Island, nor is there one in South Carolina, but a bill to that end is pending in the General Assembly.

South Dakota has no public service commission. Tennessee has a board of railroad commissioners who are ex-official tax assessors of telephone and telegraph properties. They have nothing to do, however, with fixing of rates of telephone and telegraph companies, but they do have some rights in fixing freight rates on railroads.

Texas has no public service commission, nor has Utah, but a bill creating such a commission and defining its duties and powers was introduced in the Legislature in 1909, but did not become a law.

The State of Vermont has changed the name of its Board of Railroad Commissioners to the Public Service Commission. This commission has general supervision over all companies engaged in the manufacture, distribution or sale of electricity for lighting or heating, of all express companies and of all companies conducting or operating telephone or telegraph lines, stations or exchanges within the state, and of all plants, exchanges and equipment located within the state.

Virginia has a State Corporation Commission, which has charge over all corporations, including public service corporations.



PUBLIC SERVICE COMMISSIONS IN THE UNITED STATES.

States in black have Public Service Commissions; those shaded have partial jurisdiction over public utilities; those cross-hatched have had bills introduced in recent legislatures, and are either pending or have been defeated.

Washington has a State Board of Tax Commissioners. This board is authorized by law to represent the state in any of the courts.

West Virginia has no public service commission. Wisconsin has its Railroad Commission, the duties of which are similar to the Massachusetts and New York commission, and the activities of which are well known.

Wyoming has no public service commission.

Pacific Coast Convention of American Institute of Electrical Engineers.

Successful Meeting at San Francisco, Cal., May 5, 6 and 7.

The success of the Southern Convention of the American Institute of Electrical Engineers, at Charlotte, N. C., March 30, 31 and April 1 last, was duplicated at the Pacific Coast Convention which was held at San Francisco, Cal., on May 5, 6 and 7. It is extremely probable, therefore, that the policy of the Institute to hold these special meetings will continue and that much good will result therefrom to the parent body and especially to the local sections in which these special meetings are held.

The Pacific Coast Convention was held under the auspices of the High-Tension Transmission Committee, of which Ralph D. Mershon is chairman. A program of interesting papers was arranged and these proved of great interest and evoked good discussions. The entertainments were carried out according to the program given in the April 16 issue of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN with the exception that the trip to Cliff House was abandoned in favor of a visit to the Stanford University. The arrangements were well carried out by the local committee and the presence of Lewis B. Stillwell (president) and Ralph W. Pope (secretary) of the American Institute of Electrical Engineers contributed in no small measure to the success of the meeting.

President Stillwell called the convention to order on Thursday morning, May 5, and stated that he regarded himself as fortunate in presiding at the first meeting of the Institute to be held on the Pacific Coast.

Secretary Pope in his report said it was his sad duty to announce the death of Townsend Wolcott, an early member of the Institute and identified at the time of his death with the United States Signal Service.

Before proceeding with the reading of the morning's paper, Professor Ryan addressed the convention and expressed on behalf of the local committee and the members of the loal section, a hearty welcome to the officers and visitors.

President Stillwell in the course of his reply to Professor Ryan emphasized the point that the Institute is a unit, a national organization, not a local one, and that each year should see some advance in Institute activity in different parts of the country. Through the steps that the directors have taken this year, every section is on an equality and may have a meeting on forwarding to the secretary a paper of Institute grade, the meeting to stand on the same footing as those in New York.

President Stillwell expressed the hope that the sections will avail themselves of this opportunity to hold occasional meetings and that the members on the Pacific Coast would hold a meeting at least once a year.

PARALLEL OPERATION OF THREE-PHASE GENERATORS WITH INTERCONNECTED NEUTRALS.

George I. Rhodes, assistant engineer, Interborough Rapid Transit Company, New York, N. Y., then presented his paper on "Parallel Operation of Three-Phase Generators with their Neutrals Interconnected."

Mr. Rhodes' paper is chiefly an analytical study of the difficulties of operating three-phase star-connected generators with their neutrals in parallel. The neutral currents are of triple frequency and are produced by those harmonics of electromotive forces which cannot exist between the lines of a three-phase system. When two such generators are connected in parallel a difference of potential will exist between their neutrals equal to the vector difference of the third harmonics in their coil wave forms. If the machines are exactly similar, are running at exactly the same load with the same excitation and have exactly equal instantaneous angular velocities this potential is zero and no currents will flow if their neutrals be connected. An inequality in any one of these conditions causes a neutral current to flow. The greatest trouble from neutral currents is in synchronizing. When a machine is synchronized with several others already operating in parallel, the neutral currents are even greater than when two machines are concerned on account of the parallel paths offered by the other machines. Differences in momentary angular velocities of the prime movers cause swings of load which produce corresponding neutral potentials; these are not as great as when synchronizing, however. If the neutrals are closed after the terminals are paralleled, the interchange of neutral currents is not so dangerous. Several ways exist of reducing the third harmonic and therefore the neutral potentials. One is by distributing the coil windings over 120 electrical degrees of space under each pole, instead of sixty degrees as usual; this eliminates the third harmonic entirely. Another way is by making the generator with a uniform air-gap, so that the distribution of the armature reaction flux will be of the same form as that of the magnetomotive force; also by distributing the field windings so that the field flux distribution will be sinusoidal. While these latter methods can not easily be carried out so as to eliminate the third harmonic entirely, they can at least reduce it to a negligible value. Where it is necessary to use star-connected generators in parallel, it should be specified that the neutral potentials should not exceed one per cent of the excitation electromotive force.

Professor Ryan, opening the discussion, said that the author has done the profession a real service in demonstrating that all problems which owe their origin to non-sine-wave conditions may be solved by the usual sine-wave methods applied to the multifrequency components of the original irregular alternating waves or values. The method looks complicated because of the many terms that its several frequencies introduce. Inherently it is nothing more than an extension of our common methods.

Professor Ryan also read a lengthy written discussion of the paper by Paul M. Lincoln. Exception was taken to the concluding statement in Mr. Rhodes' paper, "that alternators as usually designed and built are not suited for parallel operation with their neutrals interconnected." Mr. Lincoln stated that quite a number of generators made by the Westinghouse Company have been operated on four-wire three-phase system with the neutrals of the generators solidly connected to the neutral of the system operated, thus forming the system with interconnected neutrals as described by Mr. Rhodes. In no case where such practice is in use has attention been paid to the design of the generator with a view to reducing any disturbance which might arise from these interconnected neutrals. In operation there has never been reason for complaint on account of this connection with the single exception of the plant with which Mr. Rhodes is connected.

In view of the fact that a large number of plants are using this method of operation and that it is becoming more popular, Mr. Lincoln did not believe that Mr. Rhodes' broad conclusions are justified.

Others who took part in the discussion of the paper were Messrs. Lisber-

ger, Hall, Cory, Scattergood, Downing, Adams, and President Stillwell.

The meeting then adjourned until 2:30 p. m.

HIGH-TENSION NETWORKS.

The Thursday afternoon session was opened by the reading of a paper entitled "The Developed High-Tension Network of a General Power System," by Paul M. Downing, engineer, operation and maintenance department, Pacific Gas and Electric Company, San Francisco, Cal.

In this paper Mr. Downing dwells on the developments that have characterized the growth of high-tension transmission networks. One of the first transmission lines in the world was the sixteen-mile line from Mill Creek to Redlands, Cal., operating at 11,000 volts. Now the system of the Pacific Gas and Electric Company is one of the largest networks in the world. It represents the consolidation of several smaller companies each with a system peculiar to itself. As a result eleven hydroelectric plants are now operated by the company, having an aggregate capacity of 64,270 kilowatts. Ten of these stations operate in parallel at sixty cycles and deliver current stepped up from various voltages to a common 60,000-volt network. Additional power is also secured from four other power companies. Two steam stations and one gas engine station act as auxiliaries. The entire interconnected transmission network comprises 150 miles of 100,000-volt lines, 1,390 miles of 60,000-volt lines and 380 miles of 20,000-volt lines, or an aggregate of 1,920 miles exclusive of 11,000-volt or other lower distributing lines. The paralleling of the stations has presented no difficulties; in fact, it is carried out more readily than the paralleling of generators in the same station. Most of the paralleling is done on the 60,000-volt lines. Governing is usually done at one station only, the other stations operating at practically constant load. A load dispatcher has entire control of the operation of the system. The only disadvantage of operating the stations in parallel is that trouble on any part of the system is liable to affect the entire system. However, troubles on the long lines forming the network do not always seriously affect the entire system, but show generally only as momentary drops in voltage. On the slightest indication of trouble the system is separated into independent sections. If the trouble is far enough removed from the generating stations it is usually not such a serious matter, but if near a power house it usually throws that station out of synchronism with the rest of the system. Step-up transformers are usually delta-connected on the low-tension generator side and star-connected with grounded neutral on the high-tension line side. The low-tension side of step-down transformers is connected either delta or star, as voltage requirements dictate. The author condemns the use of pressboard or horn fiber for insulating barriers between transformer coils which is now commonly used in place of the more expensive micanite; the pressboard he finds absorbs moisture and this causes more trouble than the decreased cost of the transformer compensates for. Oil switches of the company's own design have been in very successful use on its system for many years. They are four-break switches and are hand-controlled. Since the Pacific Coast is comparatively free from lightning, no special attempt at lightning protection is made. At the power houses horn-gap arresters are installed with the gaps set so that voltages exceeding twenty-five per cent above normal will arc across. On account of there being a dry and a wet season on the coast, more insulator troubles are met with in the dry season due to accumulation of dust, salt, etc., than in the wet season, when the heavy rains wash this off. The chief trouble is from leakage. In the fog district it is necessary to shut down twice a year to permit wiping the insulators by hand. The suspension type insulator is more free from this trouble as a larger part of its surface is washed by the rain.

President Stillwell called on M. Cheever, of the Telluride Power Company, Provo, Utah, to open the discussion.

Mr. Cheever said that Mr. Downey's experience was about the same as had been found in the operation of the Telluride Power Company's system. Lightning conditions, however, were more severe in their locality than on the Coast. At present this company is using electrolytic lighting arresters which are giving excellent results.

E. F. Scattergood, chief electrical engineer of the Los Angeles Aqueduct Power Company, told about some experiences encountered in southern California.

A. O. Austin submitted the following discussion on Mr. Downey's paper:

"The extremely variable conditions effecting line insulation on this system have been pointed out by Mr. Downey and it was in connection with insulators for these lines that the writer started experimental work which resulted in the development of the high-efficiency disk suspension insulators, which have been installed on the largest lines during the past year. Most of the insulators on this system, in addition to having a large percentage of the surface protected, have large variations in diameter throughout the leakage path, and in addition, have the surfaces of highest resistance limited by small striking distances. This, with a high electrostatic stress on the small shells, is the cause of the great depreciation in insulation as the insulator beomes coated with dirt. The present insulators on this system were the best that could be had at the time they were installed. With the rapid improvement of factory conditions, however, it is now possible to make high-efficiency insulators which do not depreciate to the same extent when coated with high-efficiency insulators. I believe it possible to insulate these lines so that it will not be necessary to clean the insulation. The high-efficiency designs are small for the rating, and are so designed that the surfaces are cleaned by the wind and rain to a much greater extent than the low-efficiency insulation. With high-efficiency designs, it is also possible to provide the line with a much larger factor of safety, the suspension insulators permitting of practically any factor of safety as regards line insulation. The suspension insulators in use on the Pacific Coast are of low-efficiency type."

L. R. Jorgensen's discussion was as follows:

"With eleven different hydraulic stations to feed into a common network, the continuity of service depends more upon the character of the network than it does upon the character of the power stations. Generally the hydraulic conduit is the weakest link in power generation and transmission, but not so in this case where we have many plants delivering power into the same system. In case of electrical trouble on the system the affected portion is cut out so as not to disturb other portions of the network. If this selection of the affected portion can be done automatically, it is the quickest and easiest way. The larger the system of transmission lines the more difficult it is to lay out a system of automatic overload switching that will work out satisfactorily. In any system, however, it can only be of advantage to have the incoming feeders to substations provided with inverse time-limit overload relays. These relays will work exactly as intended, if the whole substation load can be taken from one feeder at the time, or, if not, the different feeders should feed separate busbars or separate sections of busbars. In case, however, that different feeders and busbars must be paralleled in the substation, the inverse time-limit overload relay would not work at all times as intended, and the reverse-current relay should be substituted. But if the installation can be made to suit the former relay, it is the best. The inverse time-limit relay, however, is entirely reliable. Whether the outgoing feeders from the generating station, feeding a complicated network, should be provided with automatic overload relays is a question that perhaps must be answered in each case by trial to find out if the automatic feature does more good than harm."

The paper was also discussed by Messrs. Harisberger, Hunt, Adams and President Stillwell, and at the close of the discussion the meeting was ad-

journed until 10 o'clock Friday morning.

TRANSFORMER HARMONICS.

The Friday morning session was opened by a paper entitled "Observations of Harmonics in Current and Potential Wave Shapes of Transformers," by John J. Frank, assistant engineer, Transformer Department, General Electric Company, Pittsburg, Mass. This paper was presented in abstract by G. Faccioli owing to the unavoidable absence of the author.

This paper gives the results of extended observations of the influence of harmonics in the current and voltage wave shapes of transformers. Mr. Frank made a large number of tests of these wave shapes under different conditions with the oscillograph and includes over thirty sheets of oscillograms in his paper. Typical ones of these curves were analyzed into their component fundamental, third, fifth, and higher harmonics by the method of Prof. S. P. Thompson. One of the first conclusions arrived at was that the fifth harmonic is found in the complex wave, whereas in previous investigations harmonics above the third were disregarded. It was also found that the amplitude of the third harmonic increases with the density in the core, the limiting value being dependent somewhat on the higher harmonics present. The distortion of the current wave shape in transformers is neither a cause nor an effect of the energy loss in the core, but results only from the varying permeability of the steel. The amount of the distortion varies with the density, since the greater the density the more prominent are the higher harmonics. The investigation was also extended to single-phase transformers interconnected in various ways as a three-phase bank, also to three-phase transformers and to transformers in actual service. In connection therewith was observed what are increased potential strains distributed throughout the windings of star-delta connected transformers resulting from distorted potential wave shapes. These materially reduce factor of safety of the insulation of high-voltage transformers used on long transmission lines. The final general conclusion of the author is that in any distributing system disturbances of current and potential are to be expected unless provision is made to maintain sine potential across the individual transformers.

President Stillwell called upon Professor Ryan (the author of the early paper on "Transformers" to which reference had been made in the paper just presented) to open the discussion on Mr. Frank's paper.

Professor Ryan complimented the author on his interesting and valuable paper, and Mr. Faccioli on his clear and lucid abstract, and in his discussion brought out some interesting points relating to influence of harmonics on core losses.

In reply to a question by President Stillwell, Mr. Faccioli spoke of how the use of the new silicon steel has affected the triple-frequency current, stating that its use reduces core losses but has a tendency to increase the distortion of the magnetizing current because of the lower permeability of the silicon steel at high tension. C. A. Copeland, Professor C. L. Cory, W. Hillebrand and President Stillwell also took part in the discussion.

Secretary Pope made some remarks about the typographical work done on the paper just read and the progress of the electrical art as recorded in the printed proceedings of the Institute.

The morning session was then adjourned.

TRANSMISSION-LINE CROSSINGS OF RAILROAD RIGHTS-OF-WAY.

The Friday afternoon session was opened by a paper entitled "Transmission-Line Crossings of Railroad Rights-of-Way," by A. H. Babcock, electrical engineer, Harriman Lines, San Francisco, Cal.

Mr. Babcock first points out in his paper that the early attempts at the protection of these crossings were in the nature of guard wires in some form or other, since it was realized that contact with transmission circuits is dangerous to both life and property. However, extended experience with all forms of guards, even those of the deep basket type, has shown that they fail at times to give complete protection. Furthermore, a pole line is usually worked at minimum factor of safety and it seems absurd to increase the load on it at the very point where maximum security is demanded. The rational procedure should be to construct the transmission line of maximum strength both in the crossing span and in each of the adjacent spans, so that nothing short of a general catastrophe will bring the line into dangerous proximity to the railroad right-of-way. To this end the power and railroad interests are now working harmoniously so that an economical construction of the crossing spans may be devised which will be so secure that if failure of the line occurs, it must be at some other point.

The author then gives an outline of some general specifications for the construction of such crossing spans on lines carrying more than 2,300 volts. The vertical clearance shall not be less than thirty-five feet over the top of rail and not less than ten feet above any existing wires on the right-of-way; side clearance for towers or other structures shall not be less than ten feet from the center of the nearest track. The crossing span must be carried on self-supporting towers or poles placed preferably so that this span crosses at right angles and in line with the adjacent spans. Towers of soft steel are preferred; they are to be thoroughly painted or galvanized and grounded. Steel structures are to have a minimum factor of safety of three and wooden structures of five. Cast steel or malleable iron pins are required. Below 7,000 volts porcelain or glass insulators may be used; above 7,000 volts porcelain only; insulators shall be designed for twenty-five per cent excess voltage. Conductors for 5,000 volts or less shall be not smaller than No. 6 B. & S. copper or its equivalent aluminum; above 5,000 volts not less than No. 0 B. & S. copper or its equivalent in carrying capacity and strength. Conductors shall be clamped mechanically to the insulator and also connected to the supporting structure to insure grounding if the insulation gives way. Conductors must be shielded from arcing where they pass over insulators or through clamps. Crossings should be designed for weight of conductor, plus one-quarter-inch ice, plus a horizontal wind pressure of twenty pounds per square foot on a projected area of ice-covered cable.

President Stillwell, in discussing this paper, agreed that protection should be adequate but did not think the problem a difficult one. He suggested an automatic device to cut off current on breakage of transmission lines crossing tracks, and also provision for effectively grounding the ends of wires when broken.

Paul M. Downing said that the specifications given in Mr. Babcock's paper came nearer the approval of the power companies than any yet submitted. In his experience he has found that the old basket type of guard is rather a menace than a protection on account of the long spans required and the difficulty of maintaining them.

Sidney Sprout thought that a great part of the danger spoken of could be overcome by running the wires of transmission lines underground for such short distances as are necessary to pass the railroad track.

Messrs. Cheever, Jollyman, Hunt, Adams and Harisberger also discussed the paper.

In closing the discussion Mr. Babcock urged the co-operation of railroad company and transmission company in overcoming the problems presented.

HYDROELECTRIC POWER IN IRRIGATION.

John Coffee Hays then presented his paper on "Hydroelectric Power as Applied to Irrigation."

In the first part of his paper Mr. Hays reviews the general features of prime importance to the success of a hydroelectric project for supplying power mainly for pumping water for irrigating purposes. He shows that it is imperative to make a careful study of the territory to be supplied both as to the productiveness of the soil and the amount of water available for irrigation by gravity canals and by pumping from wells. So far the latter method has been most successfully applied in orange groves, but has also been used to considerable extent for other citrus fruits as well as deciduous fruits, berries, nuts, vegetables, vines and alfalfa. The amount of water to be pumped varies materially, but in California averages about two feet in depth in addition to the average rainfall. The use of water pumped from the ground has certain advantages over gravity water, among which are the more careful use of the water and the independence which its availability gives the farmer. The development of the hydroelectric system for supplying the power will be slow because it must await for the development of the district. For this reason and because the rates for the power must be very low, the system, and particularly the distributing network,

should be constructed as economically as possible. As the district develops the lines will have to be rearranged from time to time and permanent improvements may be gradually added as justified by the increased business of the plant.

The author then describes the system of the Mt. Whitney Power and Electric Company as being a typical one of its kind. About seventy per cent of its generated power is used for pumped irrigation. It supplies a territory of about 1,050 square miles in Tulare and Kern counties, California. Over eighty-six per cent of this land must depend on pumped water for irrigation. Three forms of contracts are used in the sale of power, the most commonly used providing for a flat rate of $50 per horsepower per year. The depth of the wells varies from a few feet to ninety feet, but in most instances the water is raised above the surface of the ground, so that the total head amounts in some cases to 150 feet. During the dry season from April to October the pumping load is quite steady throughout the twenty-four hours of each day. The system consists of three hydroelectric plants of 4,850 kilowatts aggregate capacity and a steam-turbine auxiliary station of 1,000 kilowatts. In each of the stations economy of construction consistent with reasonable reliability was followed throughout. The transmission system is in the form of a figure 8 or double ring. The transmission voltage is 34,000 and that on the distributing lines 6,600 and 2,200. The distribution is two-phase from twelve substations. The new pole lines use thirty-five and forty-foot poles spaced 300 to 420 feet apart. As a whole the project is a good investment which brings very slow returns for some time, however.

In the discussion of this paper, by Messrs. Jorgensen, Henshaw, Doble and others, the desirability of building concrete ditches or tunnels instead of the wooden flumes such as described in the paper, was taken up.

M. Cheever spoke of hydroelectric power applied to irrigation in Utah, and a written discussion by F. G. Baum was submitted but not read.

The session then adjourned for the day.

The last session of the convention was called to order on Saturday morning, May 7, at 10 o'clock.

EMERGENCY GENERATING STATIONS FOR HYDROELECTRIC TRANSMISSION PLANTS.

A paper entitled "Emergency Generating Stations for Service in Connection with Hyroelectric Transmission Plants under Pacific Coast Conditions" was presented by A. M. Hunt, electrical engineer, San Francisco, Cal.

In this paper Mr. Hunt showed first that no matter what care and skill are exercised in designing and constructing a hydroelectric plant with its accompanying high-tension transmission lines absolute continuity of service cannot be assured. This is particularly true in western plants having wooden box flumes to carry the water. The best means for avoiding the serious results from interruptions of service is to reduce the period of time during which power is off the line. This can best be accomplished by having at the receiving and distributing point an emergency generating station, maintained at all times in such a state of preparedness that it can be started and put on the line in the shortest possible time.

Under the conditions existing in California, it may become necessary to operate such a stand-by plant continuously for considerable periods, due to seasons of low water, and it is, therefore, desirable that its economy should be good.

The author then discusses the type of stations for this service, making comparison between a station having generators driven by gas engines and one in which steam-driven turbo-generators are used, and attempts to show that the turbine station can be so designed as to be built at much less cost than the gas-engine station; that it can be kept in a state of preparedness where it can be put into service on the line as promptly as the gas-engine station; that its stand-by charges will be less than for the gas-engine station; and that its economy, when called on for continuous operation, will be at least as good as that of the gas-engine station.

The author assumes that the station shall have a capacity for continuous operation of 25,000 kilowatts at eighty-five per cent power factor. Crude petroleum will be the fuel used both for generating steam and for gas making.

The gas-engine station is calculated to contain twelve units, each having a continuous load capacity of 2,085 kilowatts at eighty-five per cent power-factor. The gas required per twenty-four hours is 7,500,000 cubic feet, supplied by a gas-generating plant of three oil-gas sets, with their auxiliary condensers, scrubbers, purifiers, and a holder capacity of 2,250,000 cubic feet to equalize the daily load. The station is also to have the usual compressed-air starting equipment.

The turbo-generator station is calculated to contain two turbine units, each having a continuous capacity of 12,500 kilowatts at eighty-five per cent power-factor. Each unit will have its condensing equipment. There are to be sixteen water-tube boilers of 720 rated horsepower each. All boilers are to have tight fitting dampers, which may all be opened from a central point. The oil and steam supply for burners is to be controlled from the same point. Igniters will be fitted in the furnaces which can be operated from the central point, so that fires can be started under all boilers simultaneously. In connection with the plant will be installed heat storage, consisting of vertical steel cylinders containing water at a temperature due to 200 pounds steam pressure, thoroughly protected with heat-insulating material. In these cylinders will be installed internal electric heaters having capacity sufficient to supply the heat losses from radiation and convection, the capacity of these heat-storage cylinders to be such, that by reduction of the gauge pressure from 200 to twenty-five pounds, sufficient steam will be formed to operate the plant at full capacity for thirty minutes. The cost of storage per kilowatt capacity of plant is about $5.00. The first cost of the gas-making station, is assumed as being $1,000,000, complete with buildings and storage. The cost of the electric generating station complete, including gas engines, generators, piping, switchboards, wiring, foundations and buildings will be approximately $2,250,000. At these figures, the cost per kilowatt capacity of station for combined gas and electric plant will be $130 per kilowatt. The cost of the steam-turbine plant complete, including turbo-generators, boilers, heat-storage cylinders, piping, condensers, switchboard, wiring, foundations and building will not exceed $1,500,000. The cost per kilowatt capacity of station is, therefore, $60.

In comparing the rapidity of getting into operation on the line the author assumes that the gas engines could be brought to speed and their generators synchronized and put on the line in thirty seconds, which would require a trained operator for each of the twelve engines. To keep down the pay roll he would provide only half this force and yet be able to put the station in full operation in two minutes. In the steam turbo-generator station the machines would be operating as synchronous motors to regulate the power factor. The throttles of the two turbines could be opened, the generators energized and synchronized in two minutes, during which the fires under the boilers would be ignited, dampers opened and the boilers put in condition for steaming by the time that the steam from the heat-storage cylinders became exhausted.

In comparing the stand-by charges, it is assumed that the fixed charges for interest, depreciation and taxes are ten per cent for each plant. For the gas-engine station there are provided two crews of six men each for the engines and two at the switchboard, also two crews of six men each for the gas-making plant. The combined payroll is $33,600, or an annual charge of $1.34 per kilowatt of capacity. There is also a stand-by fuel charge of sixteen cents per kilowatt. For the steam-turbine station two crews are provided, each consisting of two turbine and one switchboard operators and two firemen. The annual payroll is $12,000, or an annual charge of forty-eight cents per kilowatt of capacity. The stand-by fuel charge is also sixteen cents per kilowatt. Thus the total annual stand-by charges are $14.50 per kilowatt for the gas-engine station and only $6.64 for the turbine station.

In the comparison of the economy of continuous operation it is claimed that, after making proper allowance for the lampblack obtained as a by-product and assuming eighteen cubic feet of oil-gas to be used per brake horsepower, the number of kilowatt-hours generated per barrel of oil in the gas-engine station is 220.1. For the steam-turbine stations the number of kilowatt-hours per barrel of oil is found to be 219.6. In all the data and assumptions the author believes he has slightly favored the gas engine and yet declares he has clearly proven the superiority of the turbine station.

President Stillwell, in discussing the paper, emphasized the necessity of the consulting engineer being painstaking in investigating an engineering project so as to make it a financial success. He thought that the engineer who was in fault and constructed a plant that was not a financial success should be in some way held to account by the Institute.

This point was also referred to by Mr. Babcock, who said that engineers are too prone to look at the possibilities of physical success in plant construction rather than financial success.

Mr. Johnson stated that it must be remembered that the Market Street gas engine plant described in the paper, in producing gas for domestic service, was operating under different conditions than was a gas engine plant used solely for power service.

W. A. Doble said it was interesting,

in the comparison between waterpower and gas engines, to know that the Pacific Gas and Electric Company (which owns its own oil wells) transmitted water power for long distances and sold the oil instead of using it.

Others who discussed the paper were Messrs. Jorgensen, Cory and Dunn. A written discussion was submitted by F. G. Baum.

After Mr. Hunt's closing remarks, President Stillwell expressed his appreciation of the earnest and vigorous discussion of the paper and the hearty hospitality shown and entertainment furnished to the visiting members.

Secretary Pope offered a resolution (which was adopted) toward taking means of expressing sympathy to the British Institution of Electrical Engineers on the death of King Edward, which occurred during the meeting.

W. F. Wells, chairman of the committee on resolutions, read a resolution that the secretary be instructed to extend hearty thanks to the local committee, the Home Telephone Company, Stanford University, the Pacific Gas and Electric Company, the Great Western Power Company, Northern Electric Railway Company, Southern Pacific Company, and others, whose efforts had aided in making the convention such a pleasant and successful one.

President Stillwell, after stating the first convention on the Pacific Coast to be an unqualified success, declared the convention adjourned sine die.

SOCIAL FEATURES.

An account of the first Pacific Coast Convention would hardly be complete without a special word of praise to the local committee for the entertainment features provided. The visits have already been mentioned. On Friday evening a most enjoyable banquet was held, at which Samuel G. McMean (of McMean & Miller, telephone engineers and constructors, of Chicago and San Francisco) acted very creditably as toastmaster. The following responded to toasts: President L. B. Stillwell, Secretary R. W. Pope, and Messrs. Babcock, Brill and Hunt.

The total registration at the convention was about 175.

An ordinance has been passed in Paterson, N. J., compelling all wires in the central part of the city to be laid underground. The ordinance goes into effect in June, 1911, and the penalty for violation is $50 per day.

Electric Power in Coal Mining.

"Until recently electric power could not be applied as a motive force in the operation of reciprocating percussive tools or those which strike a blow, such as coal punchers, rock drills, etc. For this reason all of the early types of pick machines were operated by compressed air." In this manner Floyd W. Parsons comments on coal mining in a recent article on "The Advantages of Machine Mining."

Continuing his discussion he evidently refers to the Pneumelectric coal puncher when he states: "The use of steam as a motive power underground is impracticable, in the case of such machines, because of the great losses in transmission and wasteful methods of using. One mining-machinery company went a step further, believing there were numerous advantages in transmitting power by electricity, and succeeded in building a puncher machine which combines air and electricity. The main idea followed out in the construction of this machine was the utilization of air by compression and expansion in the same cylinder. This type of semi-electric puncher has passed the experimental stage and is now in active competition with the many types of air punchers."

Anaesthesia by Electric Current.

Notices have been appearing recently in the daily journals here and there regarding the anaesthetic and narcotic effect of the electric current, and representing it as something new. As a matter of fact, the first knowledge of the pain-allaying effect of interrupted currents dates back some twelve to fifteen years, though various improvements in the apparatus serving for the above purpose have been made lately. At the Congress for Electro-Biology in Berne, Switzerland, Dr. Leduc, of Nantes, declared not long ago that he has succeeded not only in causing complete anaesthesia, but also in producing a sleep similar to that brought about by chloroform, which he called "electric sleep." However, for this purpose a special current is required (Leduc current).

The nature of this current is determined by physiological conditions, for the problem is to cause a maximum of excitation by a minimum of energy. Therefore, an interrupted current must be used, and it was found that the anaesthetizing effects manifest themselves most strongly at an average frequency of 100 per second. Furthermore, the current employed must not change in direction, because the intensity that excites the nerve at the negative pole upon closing the circuit produces no excitation at the positive pole, when the circuit is closed.

In a current interrupted one hundred times a second there elapses one one-hundredth second between two successive completions of the circuit. This time interval is named a period. The circuit remains closed during a fraction of the period, and open during the remaining part of the period. Experience has shown that the excitation takes place if the current passes each time during one one-thousandth second; that is, during one-tenth part of the period of one one-hundredth second. Any source of direct current may be employed, in the circuit of which a suitable interrupter has been inserted.

Professor Leduc uses a rotating break, which opens and closes the circuit between two carbon brushes. One of the brushes is capable of displacement in order to adjust the duration of the contact, which is of great importance in practice, as the physiological and medicinal properties of the current depend on th duration of the current passage. Such interrupted currents of low tension produce a great number of physiological effects not attainable with other currents. In order to produce electric sleep in man or animal a cotton electrode saturated with lukewarm salt solution is placed on the forehead between and above the eyes, and a similar electrode on the back in the region of the kidneys. The negative pole must be applied to the head, the positive to the back. The current is interrupted 100 times per second and so that the circuit is closed during one tenth of each period. The tension is then raised gradually and slowly.

Animals have been completely anaesthized in this manner, so that any operation could be performed on them. The only two experiments with human beings were performed on Dr. Leduc himself. A current of four milliamperes and thirty-five volts was used to produce the electric sleep. When the current was discontinued he awoke suddenly, without feeling any ill effects; on the contrary, a feeling of well-being and physical power was experienced.—*Translated and abstracted from Elektrotechnische Zeitschrift (Berlin), April 7.*

THE EVOLUTION OF THE SWITCHBOARD: TWENTY YEARS' PROGRESS.[1]—II.

BY SAUL LAVINE.[2]

The introduction of the switchboard panel industry began a period which placed the switchboard in an entirely new atmosphere. It marked the beginning of the insurance stage of switchboard design, when the switchboard stepped in to take its place as a means of protection. In the natural apparatus and distributing systems, the old 200 and 500-kilowatt units were replaced by 2,000 and 5,000-kilowatt units. In place of a dozen small and electrically independent generating plants we find central power stations with substations so connected as to form one great electrical machine, all at the mercy of the switching and controlling system. With this evolution, the old voltages of 1,100 and 2,300 volts were replaced by potentials of 5,000 and 110,000 volts, thus making possible the distribution of power over very great distances, with a relatively small amount of copper wiring.

These great quantities of energy concentrated at single points would be useless and positively dangerous, but for adequate means of controlling and switching; and thus the primitive "afterthought" switchboard has developed into one of the most important pieces of apparatus connected with electrical engineering.

The switchboard is the fundamental controlling point in the design of central stations. The amount of power generated and distributed is limited by the energy and voltage which the switchboard can safely handle.

With rotary converters and storage batteries operating from the generators, it is impossible to control the generator by the exciter circuit, as in the earlier days, inasmuch as the rotaries and batteries may feed back upon the system and do great injury. It is thus necessary to be able to open these circuits when carrying full generating station output. It has been found expedient to provide automatic circuit opening devices for each feeder circuit, and to permit the alternating current generators to operate directly on the bus bars without automatic protection. With direct current generators, of course, the automatic protection is necessary.

THE REMOTE CONTROL SWITCHES.

The high potentials and large amounts of energy dealt with in modern practice have called for the development of remote control switches and metering devices. It has been necessary to remove from the switchboard all apparatus carrying the high potential currents. It was not possible to bring any but secondary and control loads to the central operating board from which the system is controlled. With this situation existing today, we have the modern switchboard, which has passed through the many stages stated above, and may now be properly termed the "forethought," or one of the first considerations in every great electrical undertaking.

Upon the design of the switchboard today depends the safety and possibilities of the system. The switchboard is comparable to the switch tower of a great railway system, where millions of dollars depend on perfect operation.

The modern panel is the result of the most careful forethought requirements. The latest switchboards have been tried and proven satisfactory; they are safe and can be relied upon to give full protection and to perform the functions for which they are designed.

The following general rules may be said to govern the design of modern switchboards:

1. There must be means of positively disconnecting every feeder from the system under all conditions of load.

2. There must be positive means for disconnecting every generator from the system under all conditions of load.

3. Under most conditions of operation, there must be automatic means of cutting off all current from a given line or section of the system during emergencies, as, example, a short circuit.

4. In a system of large capacity it is best to place the switches at a point away from the switchboard itself and often individually in fireproof compartments.

5. The whole switchboard must be constructed in such a way as to prevent the spread of electrical trouble from one portion of the board to another. Bus bars must be so located that the probability of short circuits through carelessness is very remote. In very large stations, it is best to make the bus bars remote from the switchboard itself and install them in fireproof compartments, separating the negative and positive busses. Separation for the sake of protection is carried so far today that it is common practice to erect a separate building or structure for the high potential switches and bus bars. The bus bars are frequently sectionalized so that different generating units or feeders can be operated either independently or in conjunction with the main system.

6. All devices from which flashes or arcs might emanate, such as circuit breakers on direct current or low voltage alternating current boards or expulsion type fuses, should be so placed that such areas or flashes cannot start trouble.

7. The use of all combustible materials should be strictly avoided; there should be nothing on or near these switchboards upon which flames could feed.

8. In selecting the devices for use on a switchboard, the utmost care should be given to their proper insulation, and to the extent of rupturing capacity, as well as current carrying capacity. It must be remembered that a switch ordinarily controlling a relatively small energy output will, in case of trouble, be called upon to open the entire generating capacity back of it.

RULES FOR INSTALLATION.

These general rules may be said to govern some important points for installing switchboards.

1. Ample space must be provided in front and back of switchboard, so that the operator will have plenty of room, and there will be no necessity of crowding the switchboard.

2. Allowance should be provided, that such extensions may be made in the most convenient manner, both as regards the switchboard itself and the wiring to the machines and feeders.

3. Switchboard should be placed where the operator will have a commanding view of the station. (This applies, of course, only to that part of the switchboard containing the instruments and controlling switches, or handling of switches, etc.)

4. If electrically operated switches are used, they will not necessarily be placed near the controlling board, but should usually be placed with regard to convenience of connections and safety from fire in handling. The switchboards should stand on a level foundation.

[1] Abstract of a paper read before the Pittsburg Electric Boosters' Club, Pittsburg, Pa., March 28.

[2] Engineer, Pittsburg Office of the General Electric Company.

Running a Railroad Without Accidents.[1]

It costs the people of the United States $125,000,000.00 per year for preventable accidents. According to figures which I have recently compiled, less than two per cent of all accidents upon railroads are due to hidden or latent defects or the acts of God, about thirteen per cent are due to the negligence of the public and eight-five per cent are due to the negligence of the employes. The time has come therefore, when of necessity we must devise ways and means to prevent accidents because of the greater number being the fault of our employes.

I was brought up in the old school which followed the practice that if you could not sand-bag a poor victim after you had injured and maimed him, fight him. This for years was the policy of the steam roads, and as great a man as John Newell, who for years was president of the L. S. & M. S. R. R., and one of the greatest railroad operators of his time, allowed, I am told, suits to be filed in one county alone which aggregated over $2,000,000.00, and this in a time when the public had not yet come into their own as far as obtaining even adequate compensation for their injuries was concerned. Almost every claimant was set down as a fraud, and the old companies thought they were very shrewd when they made a victom believe the company was not to blame for his injuries, or if he had the temerity to sue for damages, to have part of the jury fixed so that it was either a small verdict, a disagreement, or a verdict in favor of the company.

That day has gone by, the tables have turned, and the victim of an accident today has been educated, and educated largely by ourselves, to the fact that the first thing to do is to put up a big bluff, and the next thing to do is to hire a lawyer, in order to protect himself against the wily machinations of an adept claim agent, who as far as the imagination of the victim is concerned, is only surpassed in diabolical intrigue and cunning by the devil himself.

We have, therefore, done too much fighting and too little thinking. If we had spent one-half the time preventing that we did fighting we would have fared better. If we had spent one-half of the money preventing that we did fighting, our accident account would not have been so great. In following steam railway practice in the claim department, we inadvertently overlooked one fact, and that is that the majority of accidents on steam roads happen to employes of the road or trespassers, and the minority, or lesser number of accidents, happen to passengers. On the electric lines on account of short hauls, city service, etc., the conditions are reversed; the majority of accidents happen to passengers and the lesser number to employes or trespassers. Accidents to employes or trespassers are of course much more easily adjusted than with passengers, but even employes are getting harder to deal and settle with than they formerly were.

I believe in man; I believe in the human agency and the human element; I have faith in human beings. I don't want a cigar sign or an automaton for motorman or conductor, but what I do want is to have that human element, that human agency educated, not educated necessarily in the sense of book learning, but educated in his business so that he knows. Education being merely a result of experience and the deductions therefrom, it is not necessary for each individual to have the personal experience in order to know. You have heard managers say that a motorman is not a good man until he has had an accident, until he has had the personal experience of running off a derailer, or has met with some other mishap. That is all bosh. He does not need the experience; what he does need is to have the matter brought to his attention in so graphic a way that it will make a lasting impression upon him.

Think of the sixteen and more big disasters on the best equipped, best controlled, best officered trunk lines in the world during the winter just passed. What was the trouble? poor equipment? No. Safety devices? No. Block signal systems? No. Any proper safeguards or appliances for the better protection of the public missing? No. What was it? The human element? Yes. What was the matter with that human element? It had not been properly taught, that's all.

I do not believe in discipline as it is ordinarily meted out—five days, ten days, thirty days or discharge. Discipline does not correct evils any more than a workhouse sentence reforms a criminal—it hardens him.

You talk to a trainman today and when it comes to reflecting his ideas regarding the permanency of his situation, he will invariably tell you that he is not sure of his position over night. He does not consider his job certain. He has that innate feeling that at any time something may happen and he will get the axe. That has gotten him into a devil-may-care spirit which is also reflected in his work. It is that prevailing spirit which causes him to do his work with the idea of keeping within the rules of the company if he can and cover up his mistakes if possible when trouble comes. It is also that spirit which tends toward abuse of the machinery he has to work with, so long as he can do so without being found out. I assure our men personally that we appreciate the old men, their services are valuable, their advice is valuable, their experience is valuable, the longer they stay the better suited we are. We do not want discipline, we do not need discipline, but we do want every man so to do his duty toward his fellow beings and toward his company that there will be no need of punishing him.

Employes do not of themselves nor among themselves take up this question of preventing accidents further than merely as a matter of gossip; nor do they seem to think it a question they should bother themselves much about. To their notion is it simply a question for the management to solve. James O. Fagan, the signal tower man, author of "Confessions of a Railroad Man" and "The Industrial Dilemma," himself a member of a railroad labor organization, has said that he has never known this question to be discussed in the meetings of railroad organizations. He also says "It is actually a matter of reasonable demonstration that at least seventy-five per cent of the casualties might be avoided by increase of interest on the part of the employe and the earnest concentration of his best thought on the subject. This awakened interest, however, must not be a subordinate matter. It must be a consecration apart from and above all questions of wages, discipline or the interest of organized labor. There is no question in my mind as to the efficacy or wonder-working properties of the personal cure." Again, he says,

[1] Abstracted from a paper by E. F. Schneider, president of the Cleveland & Columbia Railway Company, read before the Central Electric Railway Association, South Bend, Ind.

"There is practically no out-on-the-road supervision on American railroads. Railroad managers depend upon the reports of employes for information in regard to volation of rules. But employes do not and can not be compelled to report their associates, consequently negligence of all kinds is practically unchecked. Unchecked negligence can be shown to be the root and direct cause of nearly all preventable accidents and loss of life therefrom on American railroads."

One more quotation: "Railroad managers therefore sooner or later will come to understand that the one thing needed in the railroad business at the present day is to educate employes to appreciate the fact that successful and safe railroading in the future will have to depend, not upon the multiplication of safety devices, or the reconstruction of rules, but upon the personal effort and conduct of conscientious, alert and careful men."

I made the suggestions to one of our superintendents ofter seeing the horrible wreck on Memorial Day of 1907, that I would like to meet our trainmen and talk the matter of accidents over with them. This was done. My first idea was to impress upon their minds that we ought to primarily look upon this question from a social, moral and humanitarian standpoint, and secondarily from a financial standpoint. I tried especially to have them put themselves in the places of the victims and their families, and would ask them their feelings toward the negligent trainman should their wife, sister, brother, father, mother or children be injured or killed under such fearful circumstances. Then I would put the financial loss into average fares, and when they found that we had to carry not only thousands but hundreds of thousands of passengers to pay for one wreck, they appreciated more fully than they could otherwise, the relative cost.

I have worked for over two years, talking to the trainmen every sixty days, giving them the best ideas and thoughts that I in my feeble way could collect, illustrating them with actual cases from our own experience when possible, when not practicable drawing conclusions and illustrations from the misfortunes of other roads. At these meetings we try to keep out all extraneous matter, and as far as possible confine our discussions to the sole topic of accidents and how to prevent them.

Some roads, I think, make a mistake by having meetings which relate to accidents, held by the operating department. These meetings should be held by the claims department in order to preclude all operating questions unless they relate directly to the matter at hand. I have tried to hold meetings just often enough not to have them become irksome or burdensome and have spent a great deal of time preparing for them. My talks are usually about forty-five minutes long and our meetings last from two to two and one-half hours. It takes eight meetings to cover our road. I have also had special meetings for employes other than trainmen, namely power house and sub-station men, car barn men, line men and track men, and I want to say to you gentlemen, you will feel proud of the men who wear overalls if you ask them to meet with you and discuss with them the moral proposition that they owe a duty to the public and the public is looking to them so to do their work that it may come to no harm.

In making the assertion that we were eventually going to run the Southwestern without accidents, one of our men said, "What are you going to do about the public? What are you going to do if a rig drives in front of the car or school children run in front of the car?" My reply was: "When you take care of your part as employes, without fault or negligence, I will devise ways and means to take care of the public." I wondered then whether I was doing my whole duty or not. We have had several distressing accidents with school children, and I want to say that I think there is no more pathetic sight, there is no more distressing place to put a man in, than to send him to a home where the only child lies dead. My assistant, Mr. McKissen, or myself with one of our superintendents, Mr. Nester or Mr. Johnson, have visited every school house, be it public or parochial, city or district, on our 217 miles of road, and have talked to every grade from the kindergarten to the high schools, making in all over 360 addresses, and speaking to upwards of 30,000 pupils. These were little talks lasting from ten to thirty minutes, and we did our utmost to impress upon the minds of all to be careful, especially when crossing a track.

In one of our talks to our men, I said I was tired of hearing the phrase which is so easily and thoughtlessly quoted, namely, "You can't run a railroad without accidents." I say you can, and that is our motto now, "The Southwestern is to be run without accidents."

Our company during the last ten years has paid out 6.35 per cent of the gross income of those years in the claims department. I have not analyzed this by years, but have taken the gross amount for ten years. In order to find out whether we were obtaining any results from the work we had started, I have kept an accurate account of the accidents occurring during the year of 1908 and 1909 and the cost for the two years has been less than one-fourth per cent of the gross receipts after making an adequate allowance for any unsettled claims. The largest sum of money paid for any one accident occurring in these two years is $750.00. We have not had a law suit for damages started against our company in the last two and one-quarter years. We have no claims as far as we know in the year 1908 that are not settled, and only one claim during the year 1909 that is not taken care of.

We have never received so many commendatory letters and so many compliments as we have had during the past year, and these are almost entirely due to the greater courtesy, the greater watchfulness, the greater carefulness of our employes, and the kindly feeling engendered by showing to the public concern for the lives and the limbs of the children.

Lighting for Mexican Cathedral.

The National congress of Mexico has had an appropriation of $60,000 for installing incandescent electric lights upon the towers of the great cathedral in Mexico City. The plans for the lighting of these towers are very elaborate, and when the illumination work is put into effect the ancient church will be brought into brilliant relief at night. It has been the practice for many years to illuminate the towers of the cathedral during the annual celebration of the country's independence, but the improvements that are now proposed will be of a permanent nature and the edifice will be kept brilliantly illuminated every night of the year. D.

UNDERGROUND ELECTRICAL DISTRIBUTION.[1]

BY W. E. HAZELTINE.

The ungainly appearance and danger of overhead electrical wires have in a large measure been accountable for the adoption of the underground system of distribution.

While the first cost of an underground system exceeds that of an overhead, security of operation tends to counterbalance this difference, for underground conductors are entirely free from the effects of storms and weather conditions.

One of the earliest attempts at placing wires underground was over fifty years ago when Professor Morse of Boston undertook to install a telegraph line between Washington and Baltimore. His method of laying was by means of a large plow drawn by sixteen yoke of oxen, the cable being placed on a reel secured to the plow and played out in the furrow as the plow advanced. It is well known that this attempt proved unsuccessful.

Several years after, the so-called "pump log" was brought into use. This consisted of eight foot lengths with a three-inch bore, the ends butting together with socket joints and laid directly in the trench. Logs were sometimes of plain wood and, again, treated with tar or creosote as a preservative.

The cement-lined iron pipe was also used to a considerable extent, but this type of conduit proved unsatisfactory, one disadvantage being that the pipe was affected by electrolysis and that the inside coating of cement sometimes caused corrosion. Both types proved inadequate to the requirements of an underground conduit.

The theoretical conduit should be one that in itself possesses high insulating properties; one upon which the action of water, gas and chemical elements have no effect, and one which is permanent and practically indestructible. These requirements are found in the vitrified clay conduit, which is best adapted to the purpose and in addition is comparatively low in first cost and in expense of installing.

Another type of conduit, which is at present used to some extent, is the fiber conduit. It is made from wood fiber treated with an asphalt compound which the makers claim renders it water, acid and alkaline proof. The standard length is about five feet, with a three-inch bore and is smooth inside; therefore, cables are safe from injury when being drawn in. This type of conduit is usually laid in concrete and lengths are joined by a butt joint which keeps them in alinement.

To return to the vitrified clay conduit, this is without doubt the most popular type in use. Duct sections are supplied with one, two, three, four, six, nine and twelve holes, the standard single duct being eighteen inches in length and three inches internal diameter. Sections of more than six ducts are difficult to handle and are not made to a great extent on account of the liability to warp during manufacture.

The flexibility of this system allows obstructions such as gas, water and sewer pipes, to be overcome by laying the duct line over or under them, and in some cases to split the duct line, placing part above and part underneath. In any case, ducts should be laid with such a gradual grade as to permit cables to be pulled in without injury to the lead sheath. Also, the use of short lengths permits the laying of curves of long radius, oftentimes doing away with additional manholes. The duct is generally laid on a bed of concrete, usually three inches thick, surrounded by walls and covered with concrete of the same thickness.

In laying single duct, a mandrel about thirty inches long, slightly smaller than the internal diameter of the hole and having a rubber gasket on the end slightly larger than the diameter of the hole, is drawn through the duct as it is being laid. This removes all loose particles of cement and stones and makes sure that there are no obstructions to injure the cables; further, care should be taken to insure that ducts are perfectly alined.

In laying a section of conduit the engineer in charge should lay out his grades so that all the ducts in each section drain into one manhole, or else break the grade so as to drain into two adjacent manholes, thus preventing injury to the cables after they are installed, from the freezing of water which may find its way into the duct line and settle in any pocket there may be.

For long straight runs, when there are no obstructions, the multiple forms of duct are usually used. These are laid in practically the same manner as the single ducts, except that joints are alined by the use of dowel pins.

One objection to multiple duct is, that between any two duct sections there is only one wall and it is impossible to break joints as with single duct; therefore, there is a possibility of a burnout in one duct finding its way to a neighboring one.

With single conduit, where there are two thicknesses of wall between any two ducts and where joints can be staggered, this danger is practically eliminated. Single duct, however, requires experienced labor in installing, while multiple duct may be laid by ordinary laborers.

Manholes are necessary in order to facilitate the drawing in or out of cables in the system and are generally located at street intersections or at sharp bends in the duct line. The maximum distance between holes should not exceed 500 feet, for at greater distances the cable is liable to break or stretch from the excessive strain during the process of pulling.

The general manhole construction is of brick, although the present tendency is towards concrete holes whenever possible, as the average cost of concrete manholes is approximately two-thirds that of first class brick. Concrete holes are usually made from wooden forms of takedown design which may be used indefinitely. Bottoms of manholes are usually of concrete, with a hollow in the center which aliows water to gather. When possible, connection with the sewer through a trap should be provided to remove any surface water which may work in around the cover.

Referring to manhole covers, authorities do not agree as to whether a single or double cover should be used. The single cover simply fits in a cast iron frame at street level. Inside of this there is sometimes another cover resting on a rubber gasket, bolted and secured so as to prevent water entering. The main disadvantage of this inner cover is that, in case sewer gas or illuminating gas escaping from leaky mains finds its way into the hole, there is no way of escape and this accounts for the majority of manhole explosions which occur.

It is believed by many authorities that the single cover is preferable and this should be supplied with several

1 From the *General Electric Review*, May, 1910.

air holes to allow gas to escape. Theoretically these vent holes should be conical in shape with the small opening on top to prevent them from becoming clogged. It is true that surface water finds its way through these vents into the hole, but this is taken care of by the sewer connection. It is well known that, with a large number of cables carrying heavy loads, considerable heat is generated and a large percentage of this is dissipated through the surrounding earth, but by using perforated manhole covers, it may be got rid of more easily.

In order to support the cables which must necessarily pass through the manhole it is customary to provide some sort of a device on which they may rest. In brick holes, brick shelves are built into the sides at suitable distances apart upon which cables are placed. Also with concrete manholes the wooden forms may be so designed as to provide for concrete shelves. The use of shelves for cable-supports is especially desirable, for in case of trouble occurring on one cable, the neighboring cables are protected to a certain extent from injury. Oftentimes with brick or concrete manholes, iron Electrolysis, therefore, proves disasable at will, are built in.

A conduit line composed of a large number of ducts is undesirable, one reason for this being that it is almost impossible to support a large number of cables in one manhole. It is advisable, therefore, to divide the underground lines from the generating station, installing a portion through two or more streets, if possible; but if the station is so situated that the entire output must pass through one street, a single conduit line with twin manholes may be used.

With a single duct line entering the station it is rather difficult to dispose of the cables satisfactorily.

Coming to the question of cable, the size of duct determines in a way the size of cable to be used. For the standard three-inch duct for working pressures of 1,500 volts or less, the largest single conductor that should be installed is a 2,500,000 circular mils, or a concentric 1,000,000 circular mils cable, while the largest three-conductor cable is one of 400,000 circular mils. From 1,500 to 3,000 volts, the largest single conductor should be a 2,000,000 circular mils cable or a concentric cable of 750,000 circular mils; and the largest three-conductor cable, one of 400,000 circular mils. For 6,000 volts (usually three-phase delta-connected), the largest three-conductor cable is one of 250,000 circular mils; for 13,000 volts, three-conductor 4/0; and for 20,000 volts, three-conductor 1/0.

As the cost of the duct line is independent of the cable cost, it is advisable to choose such cable as will reasonably fill the duct area, thereby cutting down the conduit investment to a minimum for the amount of energy transmitted. In laying out an underground system, it is advisable to provide extra ducts to take care of future requirements.

For underground work, three types of insulation are used; viz., paper, varnished cambric and rubber; paper being the cheapest, varnished cambric intermediate and rubber the most expensive. For dry ducts, where there is no danger from corrosion of the lead sheath or where electrolysis is absent or may be guarded against, paper cables may be used. Paper is also used to a great extent for trunk lines. Paper cable must not be used without a lead sheath, for the life of a paper cable is dependent upon the sheath, the presence of moisture causing the insulation to break down almost immediately, Electrolysis, therefore, proves disastrous to paper cables.

Varnished cambric cables have all the good qualities of paper cables and may be used in almost any place where rubber cables could be used. These cables are built up of successive layers of lapped, varnished cambric tape, with plastic compound between layers, this compound permitting the layers to slide on themselves when the cable is bent, without reducing the thickness of insulation between conductor and lead. This type of insulation is waterproof, and the ends of the cable do not necessarily have to be sealed to prevent moisture entering, as with paper cable. This is also true of rubber-insulated cable. Since varnished cambric tape is used in insulating, the copper core must be on the center of the cable, while with rubber insulation for heavy copper cores, used for horizontal runs at high temperature, there is a tendency for the rubber to soften, thus allowing the core to drop and reduce the thickness of insulation between copper core and lead sheath.

Varnished cambric cables with a braided finish may be used for inside work, as the insulation does not absorb moisture. These cables, unlike paper insulated ones, are not seriously affected by electrolysis.

Rubber-insulated cables are used where there is constant moisture and almost invariably for submarine use.

Paper cables may be bent to a radius equal to eight times the outside diameter of the cable, while rubber and varnished cambric may be bent to a radius of six times this value.

For direct-current low-tension and railway feeders, single-conductor cables are generally used. In some cases where two or three small feeders run parallel for any considerable distance, it is frequently desirable to combine them into one large cable running to the station.

For the grounded side of street-railway feeders, or the neutral of three-wire Edison systems, a bare wire may be used, but this should not be run in the same duct with leaded cables. An ordinary weatherproof finished wire is often substituted for this bare wire.

Low-tension feeder cables are frequently of the two-conductor concentric type with pressure wires in the outer conductor. The carrying capacity is slightly less than that of a two-conductor cable leaded flat as there is less chance of radiation; but the concentric type is easier to install and is much more economic of duct space.

For alternating-current single-phase two-wire systems, the duplex type is preferable unless many taps are called for, and if so, single conductors are sometimes used on account of the greater ease in making joints.

The largest solid conductor recommended is 4; larger conductors are too stiff to handle and should be made stranded.

Duplex or figure 8 cables larger than 250,000 circular mils are liable to kink in handling and are not used to any great extent. For larger cables the two conductors may be stranded up with fillers to make them round, and the lead applied. Any size of duplex figure 8 cable must have special care in installing to prevent kinking.

For three-phase work, it is advisable to use three-conductor cables; for, with this construction, there is no loss theoretically in the lead sheath, and, if necessary, telephone cable may be

run in the same duct system without disturbance.

On low-tension systems, single conductors are frequently used on account of the ease in making service taps.

The chief advantages in using three-conductor cable are: Cost of installing is less and installation is easier, while the first cost of a three-conductor is approximately the same as that of three single-conductor cables.

Three-phase cables are more economical of duct space than either single or two-conductor cables. Three-phase Y-connected cables are generally run with grounded neutral and the thickness of insulation between conductor and ground need only be seven-tenths the insulation between conductors, thereby allowing a slightly larger cable to be installed in conduit than a three-phase delta-connected, where insulation between conductors and between conductor and ground is the same.

The general practice in three-phase cable work is to use the so-called split type of insulation, placing half of the total thickness required on each conductor, stranding the three conductors up with jute fillers to make round, wrapping the three conductors with the second half of insulation, and applying the lead finish. This makes a more compact cable than when applying all the insulation on each conductor and is somewhat cheaper.

For arc circuits, single-conductor and also duplex cables are in general use. Where several circuits run parallel for any distance, they are sometimes combined into a multiple-conductor cable, for if several single conductors are run in one duct the lead sheath is liable to be injured in installing, and if one cable burns out, it is likely to injure one or more conductors.

One danger in underground cables which should be guarded against is electrolysis, for no manufacturer will guarantee his product against electrolytic action. The amount of electrolysis depends primarily on how near the cables are to electric railway lines, the distance they run parallel, and the condition of the return circuit of the railway, also the proximity of water pipes and gas mains. Electrolytic action occurs at the point where current leaves the lead sheath; therefore, with leaded cables, it is customary where this danger exists to provide suitable grounds at intervals along the system. Sometimes this is accomplished by driving an iron pipe into the earth at each manhole. This can be tested out with an electric current of about 110 volts, connecting one side of circuit to pipe and other side to an adjacent hydrant, and then driving in pipe until sufficient current passes to make sure that a good ground is obtained. It may be necessary to drive as much as thirty feet of pipe or more in dry soil before a good ground is reached. It is sometimes customary to provide grounds by burying large copper plates in the earth, embedded in coke. In any case all lead sheaths in the manhole should then be connected to ground.

With railway systems, the negative side of the generator is usually grounded and the lead sheath of the return circuit should be connected to the negative side of generator by suitable copper cable. If precautions are taken, the danger from electrolysis may be reduced to a minimum.

After the duct line is installed it is good practice to pass a mandrel through each duct, thus removing all obstacles and making sure that ducts aline. This is sometimes accomplished with rods about three feet long, provided with a coupling device, and as many rods as are required to reach from one manhole to another are successively joined.

At the same time that the mandrel is pulled through, an iron "fish" wire is also drawn in and left until it is desired to install cables in that particular duct, when the fish wire serves to pull through the heavy rope which is fastened to cable by a cable grip.

There are several methods of pulling cable. Short runs of light cable are sometimes pulled in by hand, but for heavy cable it is necessary to use some form of winch or manhole capstan. Both electric and gasoline-driven winches are being used with success.

It is advantageous in drawing in cable to have a man in the manhole where he can watch cable and make sure that it is not being pulled in faster than it is unreeled, thus preventing sharp bends which might prove injurious. He can also smear the sheath with a cheap grade of vaseline, which in the case of heavy cables makes them slide easier.

All cables to be installed in one duct should be drawn in at the same time, for if a cable is pulled in afterwards, it is almost sure to injure the lead of cables already installed. It is also poor practice to draw out one cable from among one or more others.

Enough slack should be allowed to permit cables being passed around the sides of manhole, and also to permit jointing, for occasionally cable ends are injured during the process of drawing in, necessitating cutting back far enough to remove injured portion.

With single-conductor cables, where a butt joint is used, the ends in the manhole should overlap slightly, and for multiple-conductor cables, where joints are staggered, the overlap should be enough to take care of this.

Ends of duct should be provided with lead collars on which the cable rests, thus preventing sharp corners of duct from injuring the lead sheaths. It is also good practice to use rubber bushings made of old hose between iron hangers and cable, which prevent leakage of stray current from one cable to another.

Cables in manholes are often protected by asbestos lining or by inclosing them in split duct, thus preventing the danger of a burnout on one cable from affecting another. This also protects cables against injury from careless workmen and prevents their being used for steps in descending into a manhole. All sharp bends should be avoided.

With high-voltage leaded cables for 2,500 volts and over, there is a tendency to puncture the insulation at the ends of lead sheath; therefore end bells are required at the station end of system, and also at the farther end where cables change from the leaded underground type to the braided overhead. These are generally of spun brass wiped to the lead sheath, their object being to flare out the lead, thus preventing a breakdown at the ends.

With paper-insulated cables, the bells are made long so as to allow of the joint being made inside the bell. A cap is provided, through which the overhead cable end passes, and after the joint is completed, the bell is filled with a compound which prevents moisture entering and also acts as an insulator.

Underground systems when connected to overhead should be protected from lightning discharges by suitable arresters placed on second or third pole from the end of the cable.

It is desirable, after cables are installed and connected to test them for five minutes with about twice the working pressure to make sure that there are no weak points due to imperfect jointing, or injury during installation.

Junction boxes are a necessity on low voltage systems and are installed in manholes at feeding points or street intersections so that in case of local trouble the feeders and mains may be disconnected.

Services are usually run from manholes or from service boxes located between manholes at street surface. Iron pipe is frequently used, so laid as to drain into manhole. For long services, cable with band-iron armor finish is laid directly in the earth. The band iron protects the cable from injury, but it is customary to place a heavy plank over the cable so that in future excavations workmen will not injure the cable with a pick.

Service cables are sometimes connected to mains through service boxes placed in manholes. This arrangement is inconvenient in case of trouble; therefore it is customary to place service boxes on customers' premises.

There are several installations of so-called Edison tube systems still in use, but at present the popular drawing-in system which this article deals with is used almost exclusively throughout the country.

New Experiments in Electro-Culture.

New results of experiments in electro-culture were made known at a recent meeting of the German Agricultural Council held in Berlin. Among others Dr. Hoestermann reported on the outcome of experiments carried out by him on the Royal Domain of Dahlem, near Berlin. Like species of plants, as strawberries, spinach, salad, radishes and carrots, were treated under four different conditions as regards the influence of electricity, care being taken that other conditions were as nearly as possible alike for all four groups. The electrical radiation was effected by means of telephone wires suspended at a height of two to two and one-half metres from the ground and at a distance of four metres from each other. The treatment of the plants was carried out in the following manner:

1. The group of plants serving as a controlling field was exposed to the natural radiations of the atmosphere (yield 100 per cent).

2. The plants of the second group were subject to artificial radiations by static electricity (yield 115 to 140 per cent.)

3. The plants of the third group were irradiated by high-tension pulsating direct current furnished by dynamos and transformers. With strong influence as regards duration and tension the yield was ninety-five to 100 per cent, with weaker influence 100 to 125 per cent.

4. The plants of the fourth group were prevented from being influenced by any electrical radiation, also that occurring in nature, by surrounding them with grounded wire cages (yield 85 per cent).

The experiments showed clearly that under certain conditions electrical radiation has a favorable influence on the growth of plants, but that a successful treatment can be effected only by a correct choice of the experimental conditions. It is worthy of note that electric currents of relatively great intensity and high pressure exert a less favorable influence, if applied for long periods, and may even be harmful. Small quantities of electricity of low pressure, on the other hand, produce a more favorable effect. It is advisable, therefore, to operate with small electrical densities and low potentials; that is, to imitate the natural conditions of atmospheric electricity. The most favorable electrical density to be employed is not yet definitely known. The treatment of group 2 was carried out by the use of a captive balloon or kites attached to a wire cable about 250 meters in length. In this manner the electricity stored in the atmosphere could be utilized.

Under the assumption that the difference of potential is 100 volts per metre the tension available at the lower end of the air wire should have been 25,000 volts under normal conditions of the atmosphere, but this fact could not be verified, as no suitable measuring instruments were available.

According to Dr. Hoestermann the humidity of the air is of as much importance as the dampness of the soil. The more moisture there is in the air, the better the results obtained by electrical radiation; in dry air it injures the plants. On the basis of his own experience he recommends that the electrical treatment should not be carried out during hot sunshine, but rather during the early morning and evening hours. The experiments will be continued this year with the support of the Department of Agriculture, Domains and Forests, and the assistance of the Allgemeine Electrizitaets-Gesellschaft.—*Translated and abstracted from Elektrotechnische Zeitschrift (Berlin), March 24.*

Permanent Technical Exhibition in Milan.

Consul Charles M. Caughy, of Milan, Italy, presents the following report as to progress in connection with the technical exposition in that city of Lombardy:

The building for the permanent technical exhibition in Milan is a somewhat imposing structure, now almost completed. It already contains several exhibits, and offers a good opportunity for American manufacturers to display their goods. Simply renting space, however, in which to exhibit wares will by no means suffice. Some active agent must be secured to explain the use of machines, the qualities of wares, etc., and supply visitors with advertising matter printed in Italian. Admission to the exhibition will be free.

Space in the hall on the ground floor or in the galleries rents for $19.30 per year for thirty-nine inches square, and in the basement $4.82. The price of space on the ground floor is increased twenty per cent if it can be approached from two sides, thirty per cent if approachable from three sides, and fifty per cent if it is isolated or is on the main passage. Advertising space costs $19.30 a year for thirty-nine inches square. Rentals are payable six months in advance, and ten per cent of the total amount must accompany the application. All correspondence should be addressed to Roberto Martinenghi, Gerente della Società Mostra Politecnica, Milan, Italy.

All exhibits must be accompanied by a detailed description in Italian and in duplicate. All expenses incurred in placing the exhibits must be borne by the exhibitor, or, if preferred, the association will attend to it, charging only the actual sum expended. Exhibits must be delivered free of all charges, and all insurance must be effected by the exhibitor.

ELECTRICAL DISCHARGES OVER PHOTOGRAPHIC PLATES.[1]

BY ALFRED W. PORTER.

It is well known that when an electric discharge is allowed to take place over a photographic plate a latent image is formed which can be developed in the ordinary way. When one electrode consists of a metal plate placed at the back, and the other is a wire brought into contact with the middle of the sensitive side, a very great difference is obtained when a single spark is passed from an induction coil or Wimshurst machine according as to whether the wire electrode is the positive or the negative one. If it is positive, the figure—which is called a positive figure—consists of numerous ram-

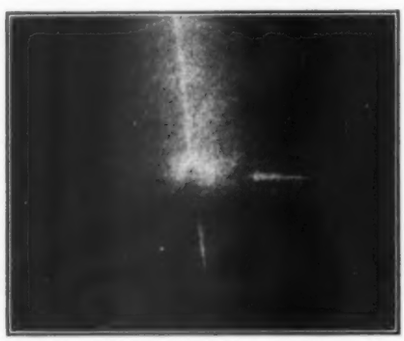


FIG. 1.—DISCHARGE AT A PRESSURE OF ABOUT SEVENTEEN CENTIMETRES.

ifications suggesting meandering streams, while if it is negative the main lines in the figure change their directions very abruptly, and are terminated by expansions suggesting fans or palm-leaves. In each case the discharge may or may not pass to the edge of the plate; if it does, the corresponding line is very broad, with a finer, well-defined, intenser line passing midway through it. Such figures were obtained first by J. Brown, of Belfast, and have since been repeated by many experimentalists. Experiments made by Prof. J. A. McClelland and Campbell Swinton seem to render certain that the latent image is due to the luminosity of the discharge, and not to a direct electrical action.

I have recently made experiments with the object of extending our knowledge with respect to the formation of these figures, and the results have been communicated to the Röntgen Society, appearing in the society's journal for January.

My first idea was that if the paths of the discharge represent moving electricity they would be seriously modified

FIG. 2.—NEGATIVE FIGURE IN COAL GAS AT ORDINARY PRESSURE.

in a perpendicular magnetic field. However, the greater part of the figure is apparently quite unchanged in such a field; the only evidence of change is in the trunk discharges that flow over the edge of the plate. These become still broader, the fine pilot spark, however, remaining apparently unshifted, and forming a sharp boundary to the trunk discharge along one edge. The direction of lateral shift is that corresponding to a wire carrying a current from the positive to the negative electrode.

A blast of air produces the same kind of effect. Indeed, if several radiating trunk discharges occur on the same plate, the effect in a perpendicular magnetic field is much the same as if

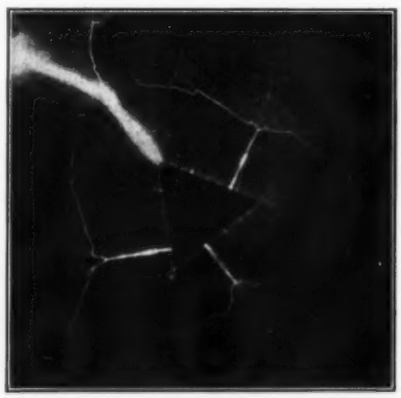


FIG. 4.—NEGATIVE STREAMERS EXHIBITING A PREFERENCE TO LEAVE THE TRIANGLE AT RIGHT ANGLES TO EDGES.

a cyclonic blast of air had circulated over the surface of the plate.

The fine tracery lines in the fan-shaped expansions which terminate the lines of discharge in the case of a negative spark are very similar to the paths of the separate portions of an exploded projectile. Such paths are easily plotted by superposing a radial component of velocity, following any assumed law, upon the initial translatory velocity of the unexploded projectile. Owing to this similarity it is suggested that these tracery lines represent the actual paths of single ions or of simple groups of ions in the electrical field.

When the discharge takes place in a partial vacuum very considerable changes occur. In particular, as the exhaustion proceeds a new phenomenon appears, which reaches its most marked stage at about seventeen centimetres pressure. This is somewhat difficult to describe, and is shown in Fig. 1.

FIG. 3.—POSITIVE RAMIFICATIONS FROM CORNERS OF TRIANGULAR ELECTRODE.

The wire terminal touched the plate nearly at its center. Besides the trunk discharge ascending the plate are seen two discharges in the shape of narrow triangles the bases of which are close to a dark space separating the glow surrounding them from a central rosette. The pointed ends are close to a second dark space, and are terminated by tuft discharges. These appearances show only imperfectly in the reproduction, but are exceedingly definite on the original negatives. The remarkable feature is the very sharp and well-defined edges which these triangles possess. It is suggested that there may be a connection between these and the phenomena of electrostriction, but so far no definite theory has been formulated. In very many cases there is visible a dark continuation of these squirts on the side of their bases, which suggests that the effects seen represent a part only of the electrical effects taking place. The shape of the squirts suggests that in one region they expe-

1 Abstracted from *Nature* (London, Eng.), March 31, 1910.

rience a pressure from the disturbance which creates the luminous glow through which they stretch, and that this pressure is replaced by a tension as soon as the second dark space is passed. The luminous glow bordered by the two dark spaces suggests a single stria as seen in a vacuum tube; the phenomena of ionization in the two cases may be similar.

When the gas in which the plate is immersed is changed the effects obtained change also. Each gas produces a negative figure characteristic of itself. The triangular squirts above referred to are given by air alone. The negative figure in coal-gas at ordinary pressure is shown in Fig. 2. The figure in nitrogen is also very singular.

When a small metallic triangle placed on the sensitive film forms the electrode, some striking differences are obtained according as it is made the positive or the negative terminal. When it is positive the ramifications start in the main from the corners (Fig. 3); on the other hand when it is negative a preference is shown to leave at right angles to the edges (Fig. 4).

Throughout these descriptions it has been assumed that the discharges leave the electrode. It must be admitted that at present there is no proof that the streamers do not represent currents that advance toward the electrodes.

For some further details, as well as for numerous other reproductions, reference must be made to the paper in the Journal of the Röntgen Society from which the figures illustrating this article have been selected. Perhaps it should be added that these are photographic positives from the original photographic negatives.

Chance for Telephone Manufacturers.

An American consul in Latin America reports that a state telephone bill is now under consideration by the local government, several experts having appeared to give testimony. He states it is considered a foregone conclusion that such a bill will become law in the near future, when an opportunity will be presented for American contractors to offer bids for the construction of this important work. They should form business connections with men in that country so as to successfully meet competitors. Particulars can be obtained by writing to the Bureau of Manufactures, Washington, D. C., quoting File No. 4916.

Belgian Prize for Electrical Research.

The Association des Ingenieurs Electriciens Sortes de l' Institut Electrotechnique Montefiore, of Liege, Belgium, recently sent out a bulletin of conditions governing the 1911 contest for the George Montefiore triennial prize.

An extract of the bulletin is given below:

Article I. A prize, the amount of which shall be represented by the accumulated interest on a capital of 150,000 francs of Belgian securities, approximately $30,000, at three per cent, shall be awarded every three years, and for the first time in 1911, after an international competition, for the best original work presented on the scientific advancement and progress in the technical applications of electricity in all branches, excepting works of popularization and mere compilations.

Article II. The prize shall bear the name "Fondation George Montefiore Levi."

Article III. Only those works presented during the three years preceding the meeting of the jury shall be admitted. They must be composed in French or English and may be printed or in manuscript. However, the manuscripts must be typewritten, and in any case the jury may decide upon having them printed.

Article IV. The jury shall be composed of ten electrical engineers, five Belgian and five foreign, under the presidency of the directing professor of the Montefiore Electrotechnical Institute, who shall constitute one of the Belgian delegates. Except as stipulated by the founder, the Belgian delegates shall be chosen from holders of the diploma of the Montefiore Electrotechnical Institute.

Article VI. In the event that the prize is not awarded or that the jury has awarded only a part of it, the entire sum remaining at disposal shall be added to the prize of the succeeding three-yearly period.

Article VII. Under the application of the preceding rules the amount of the prize to be awarded in 1911 is fixed at 20,000 francs.

Article VIII. The typewritten works may be signed or anonymous. Works that are not provided with the legible signature and complete address of the author shall be considered anonymous. Anonymous works shall bear a mark, a duplicate copy of which must be enclosed in a sealed envelope accompanying the communication; inside of this envelope the name, surname, signature and address of the author must be legibly written.

Article IX. All works, whether printed or typewritten, shall be submitted in duplicate; they must be addressed, charges prepaid, to the Secretaire-archiviste de la Fondation George Montefiore, at the office of the association, Rue St. Giles 31, Liege, Belgium. They shall bear above the text in a prominent manner the statement: "Work submitted in the competition of the George Montefiore Foundation, session of 1911."

Article XI. Works to be submitted to the jury at its 1911 session must be received not later than March 31, 1911.

Electrical Temperature Measurements of Concrete.

A recent number of the *Canal Record* contains an interesting account of measurements that are being made in the Canal Zone of the heat generated by the hardening of Portland cement. For this purpose, six resistance thermometers will be imbedded in the walls of the locks at Gatun and readings will be taken of temperature at various stages of the hardening of the concrete. The following is taken from a report given by that paper:

"From the time concrete begins to crystallize until it reaches its final set the increase in temperature is rapid. From the setting point the increase is slow, but usually continues during the whole of the hardening process, which is indefinitely long, probably lasting for several years. It is to gather data with regard to this hardening, and the heat produced by the chemical changes that accompany it, that the thermometers will be embedded in the concrete.

The thermometer consists of three parts—(1) a resistance bulb; (2) wire connecting the bulb with an indicating instrument; (3) an indicating instrument. The resistance bulb is an iron cup in which there is inserted a specially prepared metal, the resistance of which to the flow of electric current varies directly as the temperature. This bulb is embedded in the concrete at any point desired, and two copper wires connect it with the indicating instrument. The wires are encased in lead armor to make them waterproof, and their resistance is determined at

the time of installation and the corrections remain practically constant. Any number of bulbs may be connected with a single indicating instrument, but the indicator to be installed at Gatun is capable of registering for eight bulbs, although for the time being only six will be used. The indicating instrument and the switches connected with it are self-contained and mounted on a marble slab, the whole being easily portable. By closing the circuit of any thermometer, which is done by means of a push button switch, the resistance of that thermometer is measured, and the instrument records it in terms of temperature.

The thermometer is operated by one small storage battery giving approximately two volts at the terminals. The frequency with which the temperature will be taken, will be determined by the rate at which it changes from time to time. The results will be plotted with time as the abscissa, and temperature as the ordinate, and in this way a complete graphical record of the hardening and cooling of the concrete will be kept.

The Electrolytic Separation of Iron.

If it is desired to obtain iron electrolytically in layers of appreciable thickness, those of the many processes described in technical literature, which operate with small current densities, must be discarded from the beginning, says August Pfaff, as with them the deposition requires altogether too much time. For the purpose in question only greater current densities can be considered, which range, according to experience, from one to two amperes per square centimetre. The employment of these current densities, however, involves certain difficulties which have to be overcome by suitable working conditions. The tendency of electrolytic iron to contain hydrogen increases with the current density, and consequently the iron will peel off easily from the cathode. But according to researches of H. Lee, the hydrogen contained in the iron decreases with rising temperature, and by heating the bath to seventy or ninety degrees the amount of hydrogen absorbed, and consequently the tendency of the iron to peel, may be very greatly reduced.

On the other hand, the tendency of electrolytic iron to become more coarsely crystalline makes itself disagreeably prominent with higher temperatures. Hydrogen bubbles forming on the cathode, particularly when great current densities are used, also cause the deposit to be uneven. It is therefore advisable to reduce the formation of hydrogen as much as possible by avoiding the use of large quantities of acids and by a sufficient concentration of the ferro-ions, and to prevent any great variations in the concentration of the electrolyte at the cathode by lively stirring.

After describing the three chief processes embodying these general conditions, which have become known through technical literature, namely those of Merck, Burgess and Hambuechen, and of H. Lee, the author gives an account of his own experiments, from which he deduces the following conditions to be the most favorable for the electrolytic separation of iron in thick layers: sulphuric (about 0.01 normal) ferro-sulphate solution of at least 2.0 normal, a cathodic current density of two amperes per square centimetre, temperature of the bath seventy degrees, removal of the hydrogen bubbles adhering to the cathode by blowing in air which at the same time sufficiently stirs the electrolyte.—*Translated and abstracted from Zeitschrift fuer Elektrochemie (Halle), April 1.*

United Railways Investment Bond Issue Approved.

At the annual meeting of the United Railways Investment Company, stockholders approved the plan to issue $6,000,000 six per cent twenty-year convertible bonds, subject to redemption at 105 on any semiannual interest date, on sixty days' notice, the bonds to be convertible at par at the option of the holder into common stock at par, after a date, to be fixed by the board, but not within two years of date of issue.

The proposal to increase the capital stock from $50,000,000 to $56,000,000 was also approved. This increase will all be in common stock and will be reserved in the treasury of the company to be issued on demand to holders of the above-mentioned bonds in accordance with the terms imposed.

A further resolution was adopted directing that full power be conferred on the board of directors to utilize a portion of the authorized but unissued preferred stock of the company at par for payment or adjustment of arrears of dividends on the outstanding preferred stock. On any shares of the preferred thus issued dividends will accrue only from April 1 or October 1 next ensuing from the date of issue.

Directors were re-elected.

Influence of the Spark-Gap Metal on the Frequency of Electrical Vibrations.

It is generally assumed that in the discharge of a condenser by a spark the frequency of the electrical vibrations is determined according to Thomson's formula

$$n=\frac{1}{2\pi}\sqrt{\frac{1}{CL}-\left(\frac{W}{2L}\right)^2}$$

in which C and L are the effective capacity and inductivity, and W the resistance of the conductor. Measurements of the spark image with a rotating mirror made by Prof. Max Wien showed in many cases excellent harmony between the calculated and measured values of the frequency. On the other hand he found, in determining the spark decrement by means of the resonance method, that not only the decrement but also the frequency is dependent in a relatively large measure on the metal of the electrodes; resonance curves obtained with different metals under otherwise identical conditions had not only different widths, but were also displaced with respect to each other.

Compared with magnesium most other metals, particularly copper and silver, produce an increase in the wavelength, which with silver may attain a value of one per cent, and more, under certain conditions. Although this lengthening of the wave is always accompanied by an increase in the decrement, it cannot be explained under the assumption of normal damping, but can be due only to an abnormal course of the vibrations with different metals.

Professor Wien has demonstrated by special experiments that with magnesium electrodes the influence of the spark-gap on the frequency is very small and scarcely exceeds the errors of adjustment; also for other reasons, magnesium is particularly suited as metal for electrodes.—*Translated and abstracted from Physikalische Zeitschrift (Leipsic), April 1.*

Electrolytic Theory of Dyeing.

At the forty-ninth ordinary meeting of the Faraday Society, held on Tuesday, April 5, 1910, at the Institution of Electrical Engineers, London, England, Prof. W. W. Haldane Gee and William Harrison read a paper on "The Electrical Theory of Dyeing":

The literature relating to the causes of dyeing reveals great differences of opinion as to the physical and chemical phenomena involved.

The basis of the electrical theory is that when any two bodies are placed in contact they are oppositely electrified. In the case of tinctorial chemistry one of the bodies is a non-conducting solid and the other a liquid. There does not seem to be any direct method of obtaining the value of the potential difference between such bodies. The authors avail themselves of the classic theory of von Helmholtz, which enables the potential difference between a liquid and a porous diaphragm to be deduced. This may be done in four different ways:

1. By measuring the rate of flow of the liquid through a diaphragm of the substance under electrical stress (electrical endosmose).
2. By measuring the mechanical pressure obtained by electrical endosmose.
3. By determining the speed of the solid in the form of small particles when immersed in the liquid under electrical stress.
4. By measuring the difference of electrical pressure between the two sides of a diaphragm when the liquid is filtered under mechanical pressure.

The authors have determined the nature of the charge on the particles in suspension and in colloidal solution, and find that in water all basic substances are positive, the hydrochlorides of basic dyes positive, all acid substances negative, and most neutral substances negative.

They find the speed of the particles under electrical stress to be of the order 20×10^{-5} centimetres per second, per volt, per centimetre.

Negatively charged particles attain their maximum speed at a temperature of about forty degrees centigrade.

By using method 4, the authors find the approximate value of the contact difference between fibers and water to be: Cotton, 0.066 volt; silk, 0.22 volt; wool, 0.90 volt. The influence of temperature shows a maximum charge at about forty degrees centigrade, and a minimum at about eighty degrees centigrade. The electrical theory may be stated as follows:

Suppose the dye to be basic and represented by $n - P$, where n is a small negative ion and P a large positive basic ion. These ions will be free, and when wool or silk is placed in the solution the basic ions will be attracted by the negatively charged fibers, and be fixed by some process which is not yet properly understood.

The small ions will combine with the N ions present in the so-called double layer. If inorganic electrolytes are also present in the solution, and are of an alkaline nature, they will tend to make the fiber still more negative, and will assist the process of dyeing.

In the case of acid dyes they deal with a substance of the nature $p - N$, where p is now a small positive ion, and N a larger negative ion. In this case acid is either added to the bath, or the fabric has been previously boiled with acid. In each case the fiber takes a positive charge. The result will be that N will be attracted by the positively charged fiber, whilst p will form a salt in the vat. A strong confirmation of the theory is afforded by the amount of absorption of dye stuffs at different temperatures. Brown has shown that with basic colors the maximum amount of dye stuff is absorbed at about forty degrees centigrade, and the minimum at about eighty degrees centigrade. The authors' results show that the maximum negative charge is attained at about forty degrees centigrade and the minimum at about eighty degrees centigrade.

Ultramicroscopic examination of pure benzopurpurine is given after filtration, and the solution was found to contain no visible particles in the ultramicroscope. An experiment is given on the destruction of the colloidal nature of an impure sample by heating the solution.

Important analogies are given between the laws of: Contact electricity, colloidal coagulation, dyeing, and capillary ascension, and the effects of temperature are discussed.

A joint discussion on this and a previous paper, "Nature of the Action of Dyeing," by W. P. Dreaper, took place.

Dr. W. C. McC. Lewis (communicated) drew attention to the importance of the work of Professor Gee and Mr. Harrison, especially their beautiful method of showing the gradual transition from the charged colloidal state to the state of a non-electrolyte in true crystalloidal solution, as well as the remarkable temperature effects which the potential difference of the particles undergo. Had the authors determined the potential difference water/glass? This was of great importance in endosmotic work. The potential gradient at the surface of the particles can be shown to be of the order 10^{-6} volts per centimetre. Could this be withstood by water without something analogous to sparking taking place?

It was possible that the high values obtained by Lodge for the velocity of the hydrogen ion as measured in a set gelatine solution were really owing to the velocity with which the solvent as a whole carried the hydrogen ion along with it as it was impelled through the network of the jelly by the external electromotive force. Hydrolysis would seem to complicate the simple electrical theory, because the conditions of temperature and dilution under which dyeing took place were favorable to hydrolysis as well as to ionization.

Dr. V. H. Veley remarked on the peculiar maxima values obtained by Messrs. Gee and Harrison at forty degrees. Remarkable effects occurred at this temperature in many physical and chemical actions, such as the evolution of carbonic acid from leaves, or the coagulation of muscle and nerve stuff in the body.

Dr. H. Borns drew attention to some recent ultramicroscopic work in which had been observed the movements not only of colloidal suspensions, but of ions, or groups of ions, themselves.

W. P. Dreaper showed that in many cases of dyeing the conditions favorable to electrolytic dissociation were not obtained. The dissociation of the dye salt into ions and transference of one of these to the fibre area required further confirmation. Possibly the function of the electrical action was merely one of concentration of the dye within the fibre area rather than controlling the true dyeing action. Anyhow, there were many difficulties, which the speaker instanced, in the way of accepting the electrical theory so far as the fixation of the dye was concerned.

Dr. E. Feilmann also mentioned some facts that seemed difficult to reconcile with the electrical theory, such as that many dyes were used in the form of paste, and not in solution at all, and that a large class of fast dye stuffs formed true colloidal suspensions. There were, he thought, a great variety of dyeing processes.

W. R. Cooper asked whether basic dyeing would take place if a positive charge were impressed on the fabric; if not, support would be lent to the electrical theory.

F. J. Farrell quoted instances in which the splitting of the ultimate fiber, without any chemical alteration, prevented the dyeing action in the case of silks. He agreed with Mr. Dreaper that the maximum effects found at forty degrees centigrade bore no relation to actual results in practice. As a rule no good results were obtained at less than ninety-five degrees.

The chairman was of the opinion that many of the phenomena observed in dyeing could be explained merely from a mechanical point of view; the effect of temperature was an instance of this. At the same time the electrical theory might be useful in explaining the initial attraction between the dye and the fiber, even if it did not explain the fixing.

The Indiana Railroad Commission has issued a bulletin showing the changes in tariff rates for freight haulage in Indiana. The commission has no jurisdiction over the interurban lines until after the earnings from freight traffic equals thirty-three and one-third per cent of the gross earnings of the road. It is said that several interurban lines will be qualified in this respect in a short time. S.

ELECTRICALLY OPERATED CRANES.[1]

BY J. F. NISBET.

An electric crane is divided into three general parts—bridge, trolley and hoist—each of which has its own motor and controlling system, and each subjected to different conditions of work.

For the bridge where the ratio of axle bearings to diameter of wheel is between one to five and one to six, the following table will give the weights and tractions for the different spans:

Let L = working load of crane in tons; W = weight of bridge alone in tons; w = weight of trolley alone in tons; S = speed in feet per minute; p = pounds per ton required.

Span	W	P
25 feet	$.3L$	30 pounds
50 feet	$.6L$	35 pounds
75 feet	$1.0L$	40 pounds
100 feet	$1.5L$	45 pounds

For the trolley the weight and traction as shown in the following table may be assumed:

L	W	P
1 to 25 tons	$.3L$	30 pounds
25 to 75 tons	$.4L$	35 pounds
75 to 150 tons	$.5L$	40 pounds

Now the power required for the bridge will be:

$$\frac{(L + W + w) \times P \times S}{33000} = \text{Horsepower}$$

This result can be used in connection with the motor characteristics to determine the gear reduction from motor to track wheel, but as the nominal horsepower rating of a series motor is based on an hour's run with a temperature of seventy-five degrees centigrade above the surrounding air, and as conditions of bad track or poor alinement of track wheels may be met with, one and one-half times the above result should be taken as the proper size motor for the bridge.

For the trolley, the power required should be

$$\frac{(L + W) \times P \times S}{33000} = \text{Horsepower}$$

This should be used for speed and gear reductions; but one and four-fourth times this should be used to obtain the proper size of motor.

For hoist work it is impracticable to allow so large a margin of power, as the variation from full load to no load may imply a possibly dangerous increase of speed, and unless the crane is to be subjected to its maximum load continuously, or is to be worked where the temperature of the surrounding air will be high, it is safe to use a size by assuming one horsepower per ten foot-tons per minute for hoisting. This is nearly equal to assuming the useful work done as sixty per cent of the power consumed.

As an illustration, let us take a crane of fifty tons capacity; lifting speed of hoist fifteen feet per minute; bridge to be seventy feet span, and to run 200 feet per minute with load; trolley to travel 100 feet per minute with full load.

On the foregoing assumptions, the bridge would weigh fifty tons and require forty pounds per ton for traction, and the trolley would weigh twenty tons and require thirty-five pounds per ton for traction.

A convenient formula for determining the horsepower capacity is:

$$\frac{\text{Tons} \times \text{feet}}{10} = \text{Horsepower}$$

A most important feature in connection with electrically operated cranes is the magnetic or mechanical brake. The direct-current magnetic brake usually consists of a solenoid and core, which is drawn into the central position with respect to the coil.

The braking effect may be obtained either by means of horns or shoes which wholly or partially surround a flanged wheel on the motor shaft, or by a band brake placed in the same relative position, and which are actuated by the solenoid. These bands or horns are attached to the solenoid core, so that when current is in the circuit and the core is drawn up into the solenoid the motor is free to turn. At any other time the motor is immovably locked.

In many types of crane the mechanical brake is designed to hold up the load in any position, and the hoist motor is required to raise or lower the load against the resistance of the brake.

The direct-current series-wound motor has many points of superiority over the alternating-current motor for crane service. The principal advantage of this type of motor is, that at light loads, the speed increases, and at heavier loads the lifting is slower and the raising effect consequently stronger. This peculiarity of the series motor often results in considerable saving of time, due to the fact that the majority of loads in any factory are light, so that the increased speed of lift enables work to be performed in a shorter time.

When alternating current is employed for operating cranes, the nature of the service requires the use of a motor with good starting torque. Also the speed of the motor must be capable of fairly close regulation. Especially must this be so with the motors used in hoisting, and also with cranes for special work, such as machine assembling, the speed of the bridge and trolley motors must be readily adjusted. Furthermore, for simplicity in installation and operation, as well as for low first cost, it is desirable to use as few feeder wires as possible. Speed control is usually obtained by inserting resistance in the field or primary circuit.

The solenoid brake is generally applied by gravity when the current is shut off by the controller. The brake wheel should preferably be mounted on the motor shaft extension between the shield bearing and the coupling.

The solenoid itself should be arranged for mounting on a bracket which can be fastened to the crane in any convenient location and connected to the brake band by levers.

The figures following were obtained from a test on a twenty-ton crane using the following equipment: Main hoist motor, twenty-seven horsepower, 230 volts, 575 revolutions per minute; bridge motor, twenty-seven horsepower, 230 volts, 575 revolutions per minute; trolley motor, three horsepower, 230 volts, 1,000 revolutions per minute; trolley (intermittent) motor, five horsepower, 230 volts, 840 revolutions per minute.

The load lifted was 9,970 pounds; time of lifting 16.5 feet, thirty-seven seconds = 26.7 feet per minute; time of lowering 16.5 feet, twenty-seven seconds = 36.6 feet per minute.

The power input to motor lifting 9,970 pounds at 26.7 per minute is given in the following table:

	Amperes Max.	Min.	Volts.	Pwr. K.W. Max.	Min.	Pwr. H.P. Max.	Min.
Lifting from ground	...75	60	222	16.6	13.3	22.2	17.8
Lifting from mid air	...77	60	222	17.1	13.3	23	17.8

The power input to motor lowering 9,970 pounds at 36.6 feet per minute was as follows:

	Amperes Max.	Min.	Volts.	Pwr. K.W. Max.	Min.	Pwr. H.P. Max.	Min.
Lowering from mid air	60	42	222	13.3	9.34	17.8	12.5
Bridge travel 9,970 pounds plus weight of crane	...90	70	222	19.9	15.5	26.6	20.8
Trolley travel 9,970 pounds plus weight of crane	...25	10	222	5.5	2.2	7.37	2.95

The torques are given by the following:

[1] Some of the data in this paper are culled from the author's notes, collected from many sources through a considerable period of time, and in some cases, therefore, credit to the original source cannot be placed.

Starting 9,970 pounds from rest and hoisting at 26.7 feet per minute: (1) Ground, (2) Mid air.

(1) Current input: start, 75 amperes; hoisting, 60 amperes. Torque at 12 inches radius: start, 150 pounds; hoisting, 110 pounds.

(2) Current input: start, 77 amperes; hoisting, 60 amperes. Torque at 12 inches radius: start, 160 pounds, hoisting, 110 pounds.

Analysis of above tests. Efficiency of crane: (1) Hoisting; (2) lowering.

(1) Theoretical horsepower to lift load

$$= \frac{9970 \times 26.7}{33000} = 8.05 \text{ horsepower.}$$

Power input at motor, at 60 amperes, 222 volts = 17.8 horsepower.

Efficiency of motor at 60 amperes input = 83 per cent.

Power output of motor = $17.8 \times 0.83 = 14.8$ horsepower.

Efficiency of crane = $\frac{8.05}{14.8} = 54.4$ per cent.

(2) Power input at motor, at 42 amperes, 222 volts = 12.5 horsepower.

Third Avenue Taxes.

Frederick W. Whitridge, receiver for the Third Avenue Railroad, New York, has paid the Controller $660,049, representing the balance of the arrearage franchise taxes of the company, with the exception of a small item of some $5,000 which is still in the courts.

The Third Avenue Railroad Company has won in its contention with the State Tax Commissioners for a reduction in valuation placed on its special franchises in Manhattan for the year 1906. The company was assessed by the State Board at $10,525,600, and began an action to review the board's decision as illegal and erroneous by reason of overvaluation by $9,000,000. The company secured an order at the special term reducing the assessment, and this has been affirmed by the apellate division and by the Court of Appeals.

Tests with Paper-Free Mica Tubes.

In the manufacture of micanite tubes the addition of a considerable amount of paper and binding materials is necessary and for this reason the breaking down resistance of the composition is much below that of pure mica. By a process of manufacture the firm of Meirowsky and Company has succeeded in producing micanite tubes, from which paper and binding material are almost entirely eliminated. At first thin plates of mica are made from sheets by the addition of the necessary adhesive masses, the thickness of these plates being carefully maintained uniform. When winding them into tubes, each plate is pressed on the previous one until the desired thickness is obtained. An extremely high and at the same time uniform pressure in connection with a high temperature almost completely removes the small amounts of adhesive masses employed in the beginning for joining the sheets and compresses the material so that it assumes the character of natural mica, and its solidity is due rather to the friction between the mica pieces than to any fibrous substances. By heating the finished tubes for several hours the last traces of the injurious mixtures are completely removed.

Development of the Electric Sign Business.

As an instance of the results being obtained by central station conducting electric signs campaigns the development of that branch of the industry in Louisville, Ky., may be taken as typical.

According to a recent issue of the *Signs of the Times*, the developing of electric advertising in Louisville has an interesting history. Some four years ago, the Retail Merchants' Association issued an appeal through the newspapers, requesting downtown merchants to keep their windows lighted for the early evening hours during a certain week. Theretofore the only light that competed with the moon and the stars and the sun were the street lights, dim and uncertain, and a yellow glow emanating from the hotel corridors and cafes. For one special week the merchants heeded the request, and slow old Louisville was transformed into a scene of fairyland. The merchants themselves were so delighted with the transformation that they voluntarily kept their lights on thereafter and one by one they began to decorate their windows for the occasion, keeping their bright lights burning until after the theatre hours.

Electric advertising in Louisville now has set the pace for a business stride which keeps the retail district of the city fairly gasping for breath. Louisville is a noteworthy example of the development of this phase of practical application of the lightning's essence because the competing electric supply companies have reached out boldly into new fields and have created opportunities which have not heretofore existed elsewhere.

It is very probably true that Louisville has progressed more rapidly than any other city in America, in the past two years, in installing electric signs. This condition has been brought about, not entirely by rate cutting as to electric current, but because exceedingly resourceful men represent both competing companies, and if they can not induce advertisers to use electric signs by means of ordinary arguments, they succeed through other and more original channels.

Electric Station for Kansas City.

The Missouri & Kansas Terminal Building Company, of which W. B. Strang is president, has been started to build here a $2,000,000 union electric railway station in Kansas City. Options are being obtained for the site. The building will be two stories and of polished granite and Indiana limestone of the Renaissance style of architecture. Besides lobbies and waiting rooms large enough for 100,000 persons to use every day, there will be restaurants and shops of various kinds.

Four tracks will be run through it. Entrance will be through private streets or passageways, so that the outgoing passengers will not interfere with the incoming passengers.

Underneath the building will be a concourse thirty feet deep for handling express, mail and baggage. There will also be an underground connection to the new Union Station, so that all express and baggage can be delivered from the electric line terminal to the steam road station. It will connect with all the long-distance trolley lines, both city and interurban.

New Third Avenue Railroad Company Incorporated.

The Third Avenue Railway Company of New York, a reorganization of the Third Avenue Railroad Company, formed by interests which purchased the property of the old company on March 1, has been incorporated at Albany, N. Y., with a capital of $16,590,000. The stock of the new company is divided into $100 shares, and the company paid the state an incorporation tax of $8,295.

The directors of the company are: James N. Wallace, Adrian Iselin, Harry Bronner, James Timpson, Frederick H. Shipman, W. Emlen Roosevelt, Albert W. Scholle, Joseph H. Seaman, Edward A. Maher, Franklin L. Babcock, Milton Ferguson, John W. Platten, New York, and George W. Davidson, Brooklyn.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

PUBLIC SERVICE CORPORATION OF NEW JERSEY.

The combined income account of the Public Service Corporation of New Jersey and subsidiary companies reports for the twelve months ended December 31, 1909, follows:

Gross	$26,560,451
Expenses and taxes	13,331,228
Net	$13,229,222
Interest and rentals of subsidiary and controlled companies	10,111,403
Balance	$ 3,117,819
Fixed charges of Public Service Corp.	1,689,371
Surplus	$ 1,428,447

President Thomas N. McCarter says:

"During the year 1909 there was converted into stock of the corporation approximately $6,000,000 at par of an issue of $6,250,000 of convertible notes falling due November 1, 1909; the balance of the issue not converted being paid off at maturity. There was also paid off at maturity on November 1, 1909, an issue of $7,250,000 of collateral gold notes. These notes were paid off from the proceeds of $8,000,000 of the general mortgage bonds sold during the fall of 1909. Applying the earnings of the year to the basis of securities as now existing, the surplus for the year 1909 would have been $1,540,258, instead of $1,428,447, as shown by the above statement.

"The pay-as-you-enter system of collection was investigated in 1907, and 150 cars were purchased and put in service in the spring of 1908, and other cars have since been converted to pay-as-you-enter or other pre-payment type. As of this date we have 650 pre-payment cars of this general character in service. This system eliminates the missed fares. Where these cars are used the receipts have been substantially increased.

"On July 1, 1903, the amount of insurance in force on the properties controlled by the corporation was $9,455,000, and the annual premium thereon was $122,400, or an average rate of $1.29 per hundred dollars of insurance. At the present time the insurance carried amounts to $20,273,000, and the annual premium thereon is $122,909, or an average rate of sixty cents per $100. Thus the total amount of insurance carried has been more than double for practically the same premium. The total losses occurring during the same period aggregated $158,600, of which all but $22,500 was covered by insurance.

"To secure these results the corporation has authorized, up to the present time, the expenditure of approximately $200,000 for minimizing the fire hazard by installing fire extinguishers, sprinkler systems, fire hose, fire doors, parapet walls, concrete floors, etc. It is expected that additional substantial economies will be obtained in the near future, either through the further lowering of rates by the insurance companies, or the establishment of a self-insurance fund which the corporation has now under consideration."

INTERBOROUGH RAPID TRANSIT.

The New York Public Service Commission has issued a report covering both the elevated and subway divisions of the Interborough Rapid Transit Company for the quarter ended December 31, 1909, which compares as follows:

	1909	1908
Total operating revenue	$7,628,241	$6,978,511
Operating expenses and taxes	3,223,317	3,235,112
Operating income	$4,404,924	$3,743,399
Other income	96,686	245,242
Total income	$4,501,612	$3,988,641
Interest, rent, etc.	2,622,951	2,604,360
Net corporate surplus	$1,878,660	$1,384,281

HUDSON AND MANHATTAN.

The Hudson & Manhattan Railroad Company reports to the New York Public Service Commission for the quarter ended December 31, 1909, compared as follows:

	1909	1908
Total operating revenue	$572,901	$198,144
Operating expenses and taxes	331,323	153,523
Operating income	$241,578	$ 44,621
Other income	213,901	130,354
Total income	$455,480	$174,975
Rentals, interest, etc.	437,024	170,505
Net corporate surplus	$ 18,456	$ 4,470

BROOKLYN RAPID TRANSIT.

The New York Public Service Commission has issued a report for the lines comprising the Brooklyn Rapid Transit system for the quarter ended December 31, 1909, compared as follows:

	1909	1908
Total operating revenue	$5,135,907	$4,664,324
Operating expenses and taxes	3,472,799	3,399,019
Operating income	$1,663,108	$1,265,305
Other income	92,933	93,084
Total income	$1,756,040	$1,358,389
Net rentals, hire of equipment, etc.	1,530,716	1,345,413
Net corporate surplus	$ 225,324	$ 12,976

OKLAHOMA GAS AND ELECTRIC.

Earnings of the Oklahoma Gas and Electric Company for six months ending December 31, compare:

	1909	1910
Gross earnings	$291,963	$500,517
Operating expenses	166,400	309,894
Profit	125,563	190,622
Bond interest	31,073	37,795
Coupon note interest	9,000	1,500
Preferred stock dividend	7,500	36,201
Common stock dividend	.....	17,500
Surplus	77,989	106,625

These figures show rate of thirty-one per cent earned on the preferred and thirty-five per cent earned on common stock.

TWIN CITY RAPID TRANSIT.

The report of the Twin City Rapid Transit Company for the month of March and three months ended March 31, compares as follows:

	1910	1909
March gross	$598,402	$541,936
Expenses	304,774	279,307
March net	$293,628	$262,629
Charges, taxes and preferred dividends	140,229	138,963
March surplus	$153,399	$123,666
Three months' gross	1,719,319	1,550,698
Expenses	889,024	838,917
Three months' net	$830,296	$711,782
Charges, taxes and preferred dividends	420,687	406,889
Three months surplus	$409,608	$304,893

AURORA, ELGIN & CHICAGO.

The Aurora, Elgin & Chicago Railroad Company reports for March and nine months, compared as follows:

	1910	1909
March gross	$118,708	$101,972
March net	49,265	41,622
Surplus after charges	$17,002	$12,858
Nine months' net	526,288	487,732
Surplus after charges	$252,333	$236,044
Nine months' gross	$1,181,898	$1,076,989

CUMBERLAND TELEPHONE.

The report of the Cumberland Telephone and Telegraph Company for the month of March and three months ended March 31, 1910, compares as follows:

March gross	$ 568,336	$ 528,737
Expenses	320,729	300,516
March net	$ 247,607	$ 228,220
Charges and taxes	47,523	43,175
March surplus	$ 200,084	$ 185,045
Three months gross	1,665,598	1,587,007
Expenses	952,858	917,588
Three months net	$ 712,740	$ 669,418
Charges and taxes	142,863	130,549
Three months surplus	$ 569,876	$ 538,869

Chicago Battery Company Announcement.

An important change recently took place in the business of the Chicago Storage Battery Company which was formerly located at Twenty-sixth Street and Wabash Avenue, Chicago. On May 1, the Vivax Storage Battery Company, 2228 Michigan Boulevard, Chicago succeeded to the manufacture of the Duro storage batteries and the Vivax and Duro batteries will now be manufactured in the same plant.

New Electrical and Mechanical Apparatus and Appliances.

Combination Potheads and Series Cutouts.

Methods of protecting the terminals of lead covered cables have been making rapid strides forward during the

FIG. 1.—COMBINATION POTHEAD AND SERIES CUTOUT.

past few years. The introduction of detachable porcelain potheads provided means by which the construction engineer is able to terminate cables at all of the usual working voltages, with a degree of certainty as to their subsequent performance and service which was hitherto unknown. This also provided a switching feature which added greatly to the flexibility of operation.

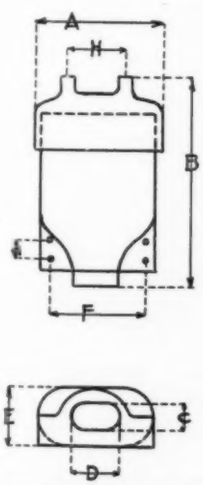


FIG. 3.—DIAGRAM OF CUTOUT.

The G. & W. Electric Specialty Company, 6408 Jackson Park Avenue, Chicago, who introduced detachable porcelain potheads about five years ago, has recently been making further improvements in the way of combination potheads. In response to a demand for a suitable means of terminating arc-circuit cables supplying series lamps on underground circuits, the combination pothead and absolute series cutout has been developed and has been very favorably received thus far. This cutout was first developed for use with single-conductor cables. Figs. 1 and 2 show a recently developed type which is suitable for use with duplex cables. The base of this device serves as a terminal pothead for the lead sheathed cables, the ends of which are well sealed from moisture by filling with compound. The metal connectors are so arranged in combination with the cap that when the cap is removed the lamp or group of lamps is disconnected and the circuit simultaneously closed. The lamps are thus absolutely cut out, limiting any possibility of a trimmer or repair man receiving any shock while the cutout is open.

Fig. 3 shows the general dimensions of the cutout. In the illustration A equals four and three-quarter inches; B, seven and three-quarter inches; C, one inch; D, one and one-half inches; E, two inches; F, three and one-quarter inches; G, five-eighths of an inch; and H, three inches. It will be noted that the small size of the device permits it to be installed in the base of an iron lamp post or in a very small hand hole. This combination device furnishes a pothead and cutout at practically the same cost as for either device separately.

The cutout is also furnished in a

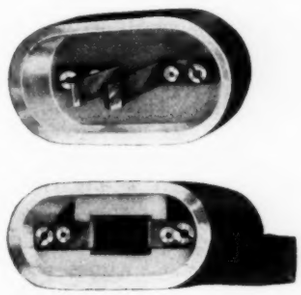


FIG. 2.—COMBINATION POTHEAD AND SERIES CUTOUT.

slightly different form for installation on overhead circuits where the pothead feature is not required, the base being inverted and the cap being made in the form of a plug which is inserted in the base from below so that the cap can be removed while exposed to the weather without danger. The absence of any iron case and the exclusive use of porcelain in the main body of the device, eliminates all possibility of break down in the series switch whether used underground or on overhead lines.

FIG. 4.—SUBWAY CUTOUT WITH COVER REMOVED.

Another combination device which is largely needed by those who are operating the underground primary distribution systems, is the subway cutout shown in Fig. 4. This consists of an iron case provided with suitable wiping sleeves in which proper terminal connections are provided for use either as a fuse box with cartridge fuses or as a disconnective box with knife blade connectors. The terminal of the cable inside of the box after being soldered to the connectors, is so arranged that it can be covered over entirely with insulating compound without interfering with the connecting device, thus sealing the end of the cable and protecting the insulation from the absorption of moisture. The iron case is made water-proof by an overlapping cover which, when installed in a horizontal position on the walls of a manhole, may be entirely submerged in water without permitting any water to enter into the box. As a further protection against the circulation of moist air inside the box, the lid is provided with a rubber gasket. These junction boxes are made for one, two, three, or four-conductor cables and for either straight connection or for half tap. The half-tap box thus saves the expense of a sleeve joint wherever it is used.

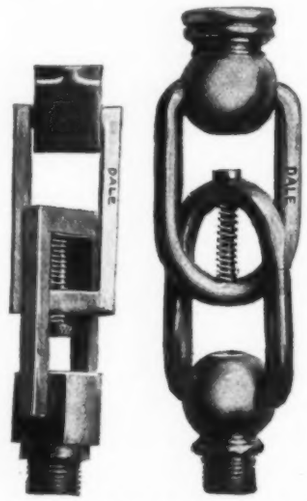
An Original Corliss Guarantee.

George H. Corliss had such great faith in his inventions, says the *Valve World*, that he did not hesitate from the beginning to accept in payment for his engines a proportion of the guaranteed savings in coal consumption, and while some of his guarantees seem to have been reckless, he was always able to do better than he promised.

An old associate of Mr. Corliss says: "In 1855 he put an engine and boilers into the James Steam Mill at Newport, Mass., the price for the equipment to be five times the amount of coal saved in one year. The old engines used on an average for the five years preceding the Corliss contract 10,483 pounds of coal a day and were fair samples of the engines in use before Mr. Corliss's time. The new engines were found to use but 5,690 pounds of coal a day, making a saving in a single year of $3,946.84, coal being reckoned at $6 a ton, making the total price paid to Corliss & Nightingale for a 180 horse-power condensing engine and boilers, $19,734.22."

The Dale Shock Absorber.

The apparent fragility of the metal filament lamps has demonstrated the necessity of a so-called shock absorber to counteract the vibrations and shocks commonly subjected to a lamp. It is also conceded that though the newer types of tungsten lamps may be suspended at any angle without disastrous results, to obtain the maximum life of these metal filament lamps they should be suspended in a perpendicular position.



TWO TYPES OF DALE SHOCK ABSORBER AND LAMP ADAPTER.

The device, shown in the accompanying illustration, is particularly worthy of attention in this connection, as it combines both the functions of a shock absorber and lamp adapter, and in addition forms an attractive addition to the popular modern fixtures now commonly used.

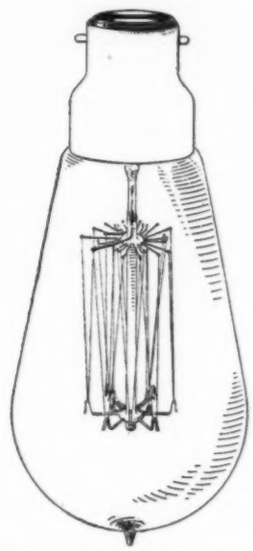
APPLICATION OF DALE SHOCK ABSORBER AND LAMP ADAPTER.

Two of the illustrations show two styles of this "missing link" as it is called, one the square link and the other the round link. The swivel feature which may be seen at the top of each link adapts itself to any angle, permitting the lamp to assume a perpendicular position. The vibrations are absorbed by the spring seen between the upper and lower links.

This combined shock absorber and adapter is being manufactured and placed on the market by the Dale Company, Ninth Avenue, Thirteenth and Hudson Streets, New York, N. Y.

Small High-Voltage Metal-Filament Lamps.

The accompanying illustration shows a forty-watt, thirty-eight-candlepower, 200-volt, metal-filament lamp which is typical of a new line of small high-voltage metal-filament lamps lately put on the market by the firm of Galsworthy, Limited, of London, England. In order to successfully accommodate the filament within the small bulb, the loops are arranged in two concentric rows in such a way as to give the maximum distance between them. A relatively great strength is also attained by this method of construction.



SMALL HIGH-VOLTAGE METAL-FILAMENT LAMP.

A New Telephone Mouthpiece.

The ordinary composition or hard rubber mouthpiece is easily broken and a source of considerable expense to a company in the course of a year.

The ordinary steel mouthpiece removes this objection but is dangerous, as it is a ready conductor of electricity and a source of danger during storms

or through crossed wires. The common metal mouthpiece is affected by dampness and corrodes easily.

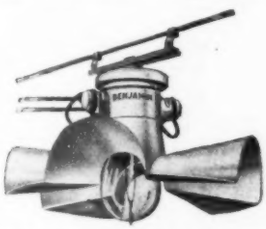
Taking these things into consideration the Kellogg Switchboard and Supply Company has combined the advantages and eliminated the objections of the two styles, in the design of their new reinforced rubber-covered steel mouthpiece.

This mouthpiece has a perforated steel shell covered with a coating of hard rubber moulded over it at great pressure and heat. As the rubber is forced through the perforations and around the shell, it makes an absolutely unbreakable mouthpiece.

The threaded portion is made directly on the steel at the base, eliminating danger of breakage at a point where most rubber and composition mouthpieces give way.

The Benjamin Parabolite.

The Parabolite is a new fixture of the Benjamin Electric Manufacturing Com-



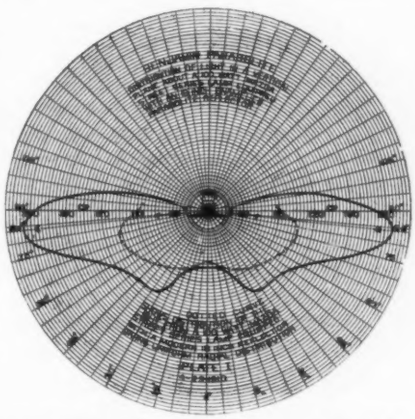
THE BENJAMIN PARABOLITE.

pany, of Chicago, Ill., for street lighting with series Mazda lamps.

By means of a porcelain enameled steel reflector composed of four intersecting semi-parabolas surrounding the lamp, the greater portion of light is projected down the center of the street, and only the necessary minimum amount is allowed to reach the street corners. As a result the light secured for the street proper is said to be increased more than fifty per cent, as compared with the usual amount when allowed to radiate over 360 degrees. Where it is desirable to suspend the fixture in the center of the block, reflector with two instead of four semi-parabolas is furnished.

The body of the device is composed of a porcelain base forming the main part of the socket, and integrally formed knobs. This base is supported by an iron fitting attached by four screws. The fitting in turn is covered by a porcelain petticoat insulator, which is held in position by a metal bushing screwed into the supporting casting.

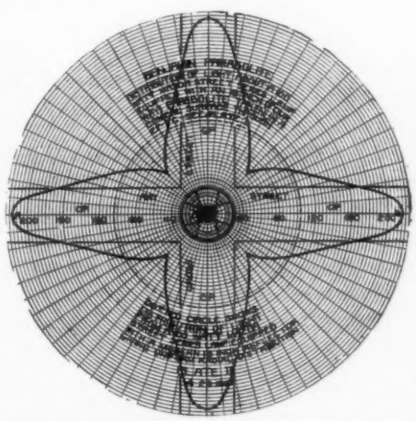
The porcelain knobs are located as nearly as possible in line with the bottom of the metal supporting flange. The strain of the wires has therefore



DISTRIBUTION OF LIGHT IN A VERTICAL PLANE ABOUT A 100-WATT MAZDA LAMP EQUIPPED WITH PARABOLITE.

little or no leverage, and the danger of breaking the insulator is thus lessened. The binding plates are well protected, and readily accessible.

The socket is provided with a spring center contact serving as short-circuiting device when the lamp is removed or accidentally loosened. It thus prevents the film from being punctured except when the lamp filament is broken. A heavy porcelain ring carrying the threaded socket shell and film cut-out is connected with the main socket by means of a bayonet snap lock, and



DISTRIBUTION OF LIGHT ABOUT A 100-WATT MAZDA STREET SERIES LAMP EQUIPPED WITH PARABOLITE.

can only be removed by pulling the porcelain downward and turning it to the left. The strain of placing or removing the lamp cannot unlock connections.

A Unique Electric Vibrator.

What is perhaps the most inexpensive and at the same time practical and reliable electric hand vibrator that has yet appeared on the market is the handy little machine recently put out by the Illinois Appliance Company, 613 Crilly Building, Chicago, Ill. The vibrator itself, together with six feet of silk-covered cord, plug, and three applicators for body, facial and scalp massage, respectively, are all contained in a neat leatherette case no larger than a lunch box, as shown in the accompanying illustration. It is estimated that at the rate of only three facial massages a week, the instrument will pay for itself in about two months, the cost of current required to run it being negligible.

In this vibrator, while every means has been taken to reduce weight to the absolute minimum, the construction is

THE ADAPTABLE MASSAGE VIBRATOR.

unusually rugged and is well adapted to withstand quite hard usage.

The outside case is of polished aluminum. The motor comprises a laminated field and armature and comparatively heavy conductors to prevent overheating, and special self-oiling bronze bearings further contribute to the good running qualities of the apparatus. The motor brushes are of carbon, and a cut-out switch is also provided. The vibratory movement is made of oil-tempered steel, each part being specially selected and designed for the particular use to which it is put. The vibration mechanism is designed to run at 4,500 vibrations a minute, which speed was specially selected after some research as being the one most particularly suited to give just the right kind of vibration, not too rough and not too weak, to produce the most beneficial effect. The vibrator weighs only one and a half pounds.

THE CONSTRUCTION AND OPERATION OF AN AMERICAN FLAMING ARC LAMP.

BY L. J. AUERBACHER.

It is now five years since the flaming arc was commercially introduced into the United States, and owing to its high efficiency it has developed a large field of usefulness for this type of lamp along the general lines of arc lamp lighting. The first flaming arc lamps which were imported were of a type having a differential clockwork mechanism, which fact naturally retarded their rapid introduction and use by large consumers.

One of the most radical and practical improvements made in flaming arc lamp designs, was that made a few years ago by which a carbon was held by a metal support at the arc, and the gradual burning away of the carbon allowed it to sink down slowly, thus feeding the lamp without the use of complicated differential mechanism. This basic principle has done much to eliminate the prejudice formerly held against flaming arc lamps owing to their complicated construction. Notwithstanding the simplicity of this invention it took several years to develop a lamp which was commercial as well as dependable in operation. An American lamp which embodies these principles has been placed on the market by the Western Electric Company and is known as the Hawthorn flaming arc.

Fig. 1 of the diagram shows the lamp mechanism, in which its simplicity is apparent. The operation of the lamp is as follows: When the current is turned on this lamp a series magnet is energized, which operates a pantograph lever and pulls the carbons apart in a parallel position. In the direct current lamp the negative carbon has a rib or projection on one side which rests on the copper support shown in Fig. 2 of the diagram. The current is fed in at the copper support as well as at the carbon holder, thus cutting out the carbon resistance and at the same time assisting in burning away the rib support.

The principle underlying this lamp is that the carbon is cooled at a point furthest away from the arc by reason of its resting on the copper support, thereby disintegrating gradually without injury to the support. These carbon supports become charred in time and are renewed every three to six months. They cost only a few cents and are really the safety valve of the lamp, in which the trouble, if any, concentrates. The trimmer can renew one without any difficulty and lamps unless injured mechanically do not have to go to the shop. Fig. 3 of the diagram illustrates the renewal copper support. A dash pot is attached to the solenoid core to prevent the too rapid pulling apart of the carbons.

The lamps operate under all usual service conditions and can run two in series on 110-volt circuits as well as four in series on 220-volt circuits. When four or more lamps are run in series, an automatic cutout is mounted in the lamp, together with a substantial resistance. When any lamp of a series cuts out, the circuit is automatically closed through the resistance, and the current and other characteristics of the circuit are maintained.

This type of lamp has been very successful on twenty-five-cycle railway circuits, having wide voltage fluctuations, which clearly indicates that the rib carbon supporter feed is very efficient.

The Hawthorn flaming arc lamp, in addition to using this modern and simple feed, has other features of construction which are worthy of attention. All parts are heavy and well nickeled. The carbon holders are substantial and will stand the abuses to which the average trimmer subjects them.

The parabaloid globe used gives the best distribution, tending to increase the horizontal candle power. The case is heavy and the catches are substantial and easily handled.

Lamps burn normally at ten amperes, two in series on 100 to 120-volt circuits, consuming about 550 watts and giving a mean low hemispherical candle power of 2800.

It is interesting to note that the German Navy has adopted this type of lamp after a year of exhaustive tests.

HAWTHORN FLAMING-ARC LAMP COMPLETE.

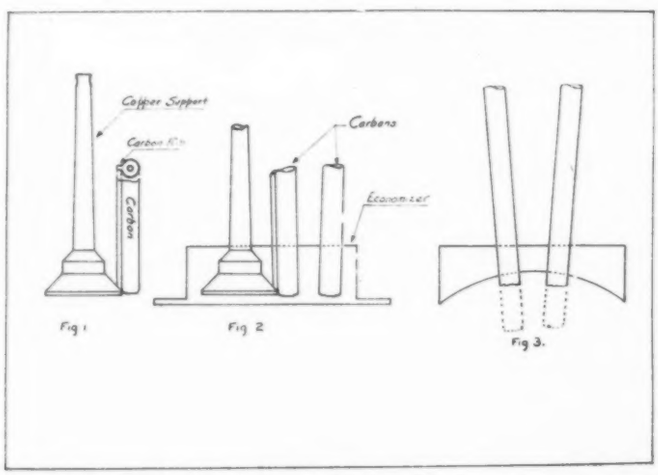


DIAGRAM SHOWING STAGES OF OPERATION OF HAWTHORN FLAMING-ARC LAMP.

POSITION OF CARBONS WHEN LAMP IS OUT OF CIRCUIT.

West Penn Railway Company

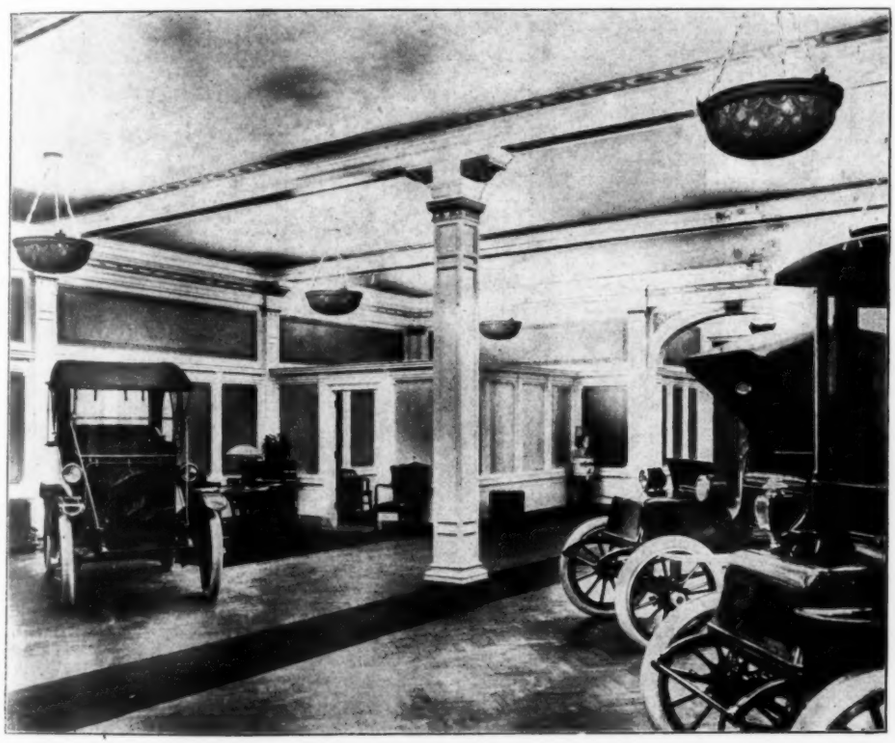
Stockholders of the West Penn Railway Company have voted to increase the bonded indebtedness from $6,000,000 to $12,000,000. The new bonds are for improvements and extensions and will be issued from time to time as extensions are made. The plan whereby the American Water Works and Guarantee Company will assume control of the company has been declared operative.

Indirect Illumination.

Since the practical working out of indirect illumination was presented, it has made great advance in public favor, and its charm and beauty have been realized and interest in its development has grown in all sections of the country.

The perfection of the I-Comfort system of indirect illumination has been most opportune. A one-piece silver-plated reflector of correct scientific design is contained in artistic fixtures. The light is thrown to the ceiling and from there diffused throughout the room, giving an illumination which closely approaches daylight.

Although it was first supposed this system would be largely used for residences, it has found great favor in almost every character of interior where the ceilings are flat and of light color.



INDIRECT ILLUMINATION IN AUTOMOBILE SALESROOM.

An attractive installation of this character is that of the South Shore Country Club Auditorium, Chicago. This was the first interior of its size to be illuminated with this system. Since then numerous other auditoriums, churches, banks, libraries, schools, lodge rooms, etc., have adopted it. Perhaps the greatest number of installations have been made in counting rooms where it has acquired great popularity with the heads of large commercial institutions who find that by using it in places where large numbers of employes are necessary, and much clerical work must be performed under artificial light, it effects an appreciable saving of the employes' nervous energies, which may be better applied to the employers' advantage.

Advertising benefits are also said to be derived from this method of illumination. In this connection attention is called to the accompanying illustration showing the indirect illumination in an automobile salesroom on Michigan Avenue, Chicago, which is said to be attracting the attention of those who pass this building.

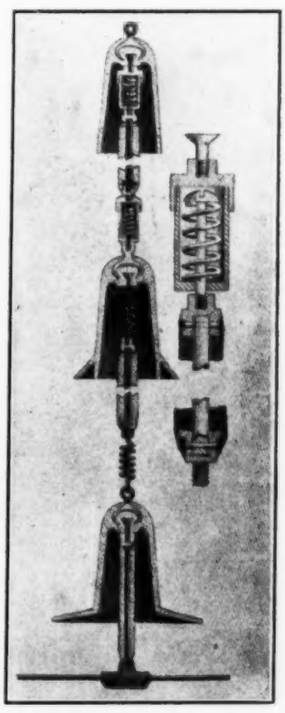
The one-piece glass reflectors used in this room have spiral and vertical corrugations which break up the rays of light and throw them without shadow from the filament or either the chains or arms of supporting fixtures.

The fixtures used are of the bowl type as shown in the illustration, the bottom of each consisting of open-work. These are lined with golden colored silk which allows sufficient light from the ceiling to be diffused through the open-work to give the fixtures a soft glowing appearance which eliminates the dead effect so common in large fixtures. They are finished in Roman gold which blends very nicely with the interior decorations.

Being of a special composition, these fixtures are comparatively inexpensive in price and in addition, can be decorated to match or counterpart almost any finish and to harmonize with the interior decorations of any particular place. The reflectors are placed within the bowls on a level with the top of same and are entirely hidden from view. It will be seen from the photograph that no exposed lights are in sight.

A New System for High-Tension Insulation.

A patent recently issued to Louis Steinberger of Brooklyn, N. Y., covers a novel and improved system of insulation for high-potential electric conductors to be used in various relations and for various purpses, such as power transmission and for guy wires or cables employed as stays for towers or poles, masts, and other supports used in wireless telegraphy and telephony, as well as in regular commercial work. It marks a radical departure in the development of insulator systems.



HIGH-TENSION INSULATION.

The system comprehends a series of insulators, preferably of a thimble type,

and a series of other insulators of a rod type, the thimble-type insulators being alternated with the rod-type insulators, and together therewith forming a flexible chain of parts which may be extended indefinitely.

The under surface of the thimble-type insulators will be, of course, at all times comparatively dry. Each thimble-type insulator acts like an umbrella covering the upper end of the rod-type insulator below it and connected therewith by keeping it dry under the most unfavorable conditions (as, for instance, when all the insulators are subjected to the action of a driving rain); hence the group of insulators must always afford adequate insulation for all practical purposes. This system will practically prevent leakage and undesirable grounding of the current either from conductors or from supporting structures for the same.

In this system the various parts may be readily detached and replaced by other parts, and the total number of parts may be increased or diminished at will after the original structure is built, this feature being especially important in instances where, after the installation of a conductor, the voltage is to be increased.

Not the least important feature of the system is the flexibility of the chain of units.

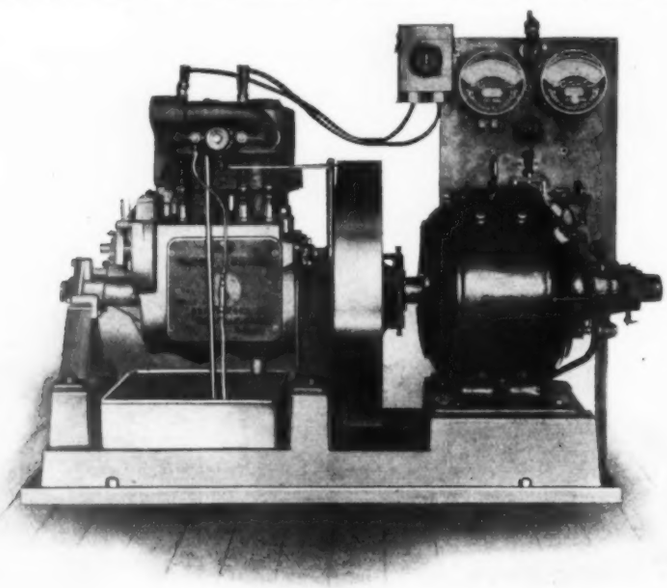
These insulators are being manufactured and placed on the market by the Electrose Mfg. Co., Brooklyn, N. Y.

The Brush Balanced Engine and Direct-Connected Lighting Set.

A good many gas engine makers, when asked to supply absolutely reliable constant-speed gasoline engines for the purpose of driving electric generators, take the stand that such a thing is an impossibility. Realizing the demand for such an engine and knowing that variation of speed with the hit and miss type of governor were unavoidable, the Chas. A. Strelinger Company, of Detroit, Mich., has developed a stationary engine with a throttling governor.

That the Brush balanced engine does give remarkably close regulation is shown by a series of photographs that were taken of the voltmeter and ammeter under different loads. Although a number of loads were tried and the current was varied more rapidly than it would be in actual practice, the change in position of the voltmeter needle is so slight as to be hardly noticeable.

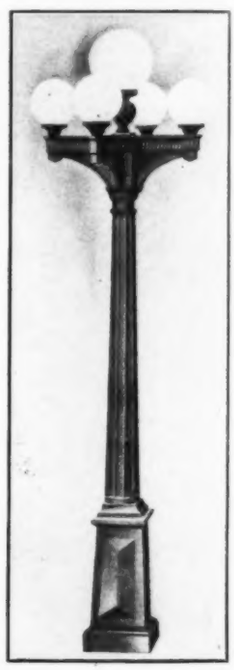
The engine, together with an electric generator and suitable switchboard are all sold by the company, and the neatness and compactness of the set may be seen from the accompanying illustration. A ten-horsepower two cylinder vertical engine drives a four kilowatt 115-volt, or thirty-five volt, direct-current generator. The ignition is of the jump-spark variety, current being supplied by a six-cell wet battery. For the portable generating set sixteen dry cells connected in multiple are used. As it is not necessary to use a heavy flywheel with this type of generator, the total weight of the set is 1,500 pounds, while it is quite common to find gas engines of no greater capacity than the Brush which weigh 5,000 pounds. The switchboard is furnished with voltmeter, ammeter, rheostat, main switch and two line switches. The instruments supplied with the set are manufactured by the Weston Electrical Instrument Company.



THE BRUSH DIRECT-CONNECTED LIGHTING SET.

Street Lighting Standards.

In the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for April 23, 1910, there appeared an illustrated description of the Corinthian design standard for ornamental street lighting. The Flour City Ornamental Iron Works, Minneapolis, Minn., the manufacturer of this type, are also manufacturing and placing on the market the standard shown in the accompanying illustration, known as the Egyptian five-light standard.



EGYPTIAN FIVE-LIGHT STANDARD.

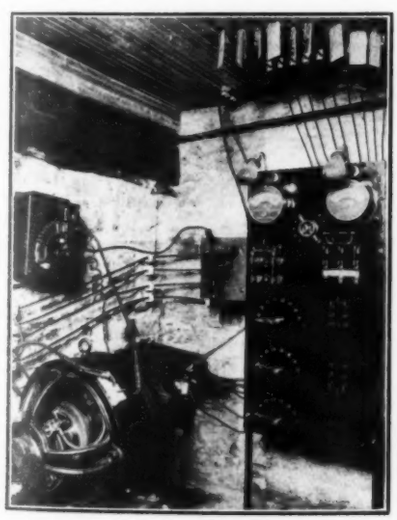
The design of this type is also simple and effective and the same high grade of material and workmanship enters into its construction as in the Corinthian design. The bases are set on solid concrete blocks into which are imbedded four steel bolts. The globes are of hail-proof opalescent glass, frosted on the inside

Meat Curing by Electricity.

An interesting installation in the city of St. Louis, and one which should be of interest to electrical visitors is the electric meat curing plant installed in the Krey Packing Company's packing house at Twenty-first and Bremen Streets.

VIEW OF VATS IN WHICH MEAT IS CURED.

In the electric curing of meat at this plant a battery of five wooden tanks or vats is employed. At each end of the vats are placed a number of porous cups approximately six inches in diameter and a little deeper than the depth of the vat. Inside each cup is a graphite rod and fastened to each rod is a wire for making electrical connection between the graphite electrode and the wire carrying the current from the dynamo to the vat. The vats and cups are filled nearly to the top with ordinary pickle.



SPECIAL SWITCHBOARD USED.

Direct current at 115 volts is led to a corner of the engine room where it passes through a rotary transformer, transforming it to sixty-cycle alternating current. The switchboard controlling this current is equipped with one transformer, one voltmeter, one ammeter and a rheostat. A view of this board is shown in an accompanying illustration. The current passes though the porous cups into the pickle brine, which fills the vat, and through the vat filled with meat to the porous cups and electrodes at the opposite end.

The meat is laid in the empty vat between the porous cups in layers, separated by wooden racks, it being necessary to use the racks for separating the meat so that the process of cooling may not be retarded. After the vat is filled with meat packed in this way it is filled with pickle, and the current turned on. The meat is left in the electric bath until cured.

At the end of the time required for the cure, pickle is drawn off from the vat, the meat is removed, the vat is refilled with new meat, and the old pickle together with enough of new to bring the pickle up to proper saturation, or to replace what the meat has absorbed, is replaced in the vat, the current is again turned on for another three or four days, and thus the process of curing goes on. The meat itself is washed after being removed from the vat, and is hung up and smoked in the ordinary way, and shipped either in bulk or after being canvassed.

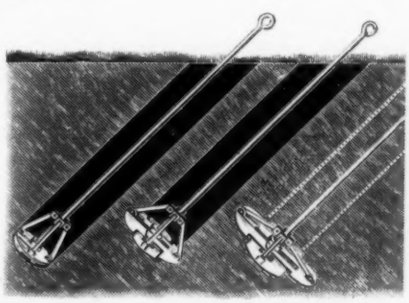
The most noticeable difference between the electric process and the old process of curing meats is in the great saving of time effected by the electric process.

The plant described was installed by the Electric Curing Company, Cleveland, Ohio, under the direction of W. A. Pearse, engineer for the company.

The Everstick Anchor.

The Everstick Anchor Company, St. Louis, Mo., is placing on the market an anchor, called the "Everstick," which has many commendable features, among which may be mentioned their malleable iron, solid construction; their design, allowing the anchor to expand into solid and undisturbed earth at the bottom of the hole and the fact that there is no vacuum under the anchor, to hold water after being installed.

The accompanying illustration shows three stages of the operation of installing an Everstick anchor. The view on the left shows the anchor placed in the hole, the next view shows the anchor partially expanded and the view on the right shows it fully expanded. The expanding is done by striking the anchor with a tamping bar, and the operation is said to require less than one-half a minute of time. The only tools needed to install the Everstick anchor are an auger for boring the hole, and a tamping bar.



THREE POSITIONS OF ANCHOR DURING INSTALLATION.

Among the claims made by the manufacturers are the following: The Everstick anchors will not creep; will not break, are very quickly installed, are everlasting.

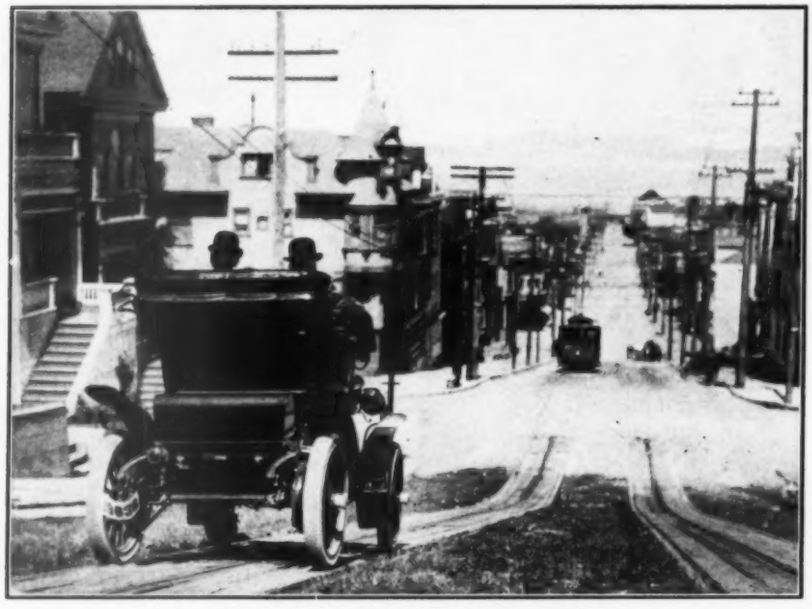
Electric Vehicles for Hill Climbing.

The efficiency of the electric vehicle has probably been nowhere better demonstrated than in San Francisco recently where a test was made on one of the city's steepest hills to illustrate the hill-climbing capabilities of a "Detroit Electric."

ELECTRIC VEHICLE ASCENDING FILLMORE STREET HILL.

The Fillmore Street Hills, San Francisco, were chosen, not only because of the fact that no electric vehicle has ever climbed them before, but also for the added contrast between the power of the electric automobile and the electric trolley car, which on this street has to be hauled up the hill by the old cable system.

The car, which is manufactured by the Anderson Carriage Company, Detroit, Mich., made a standing start from the foot of the hill and continued without pause to the top. It was then turned and coasted down the hill, making several stops to show the efficiency of the countershaft brake of the "Detroit," which has been tested at an angle of forty-five degrees and which holds the car with normal pressure of the foot. The accompanying illustrations show the car ascending and descending a twenty-seven-per-cent grade in the test mentioned above.



DESCENDING FILLMORE STREET HILL.

New Type of Service Box.

A line of service boxes embodying entirely new features is offered the trade by the Detroit Fuse and Manufacturing Company, Detroit, Mich. In addition to being water tight and rust proof, the "Detroit" service box is a quick make-and-break fusible switch.

The manufacturers claim a number of advantages not found in other lines and are calling particular attention to the fact that the switch mechanism is operated from the outside of the box, can be controlled instantly, and without danger of accidental short circuit. This feature is appreciated when installations are made in manholes or in damp basements, for which service this line is especially recommended. Also in replacing blown fuses, you do not touch or come in close contact with any live parts. The switch mechanism is simple, and is controlled by one spring of sufficient strength to throw the switch either on or off independently of other pressure.

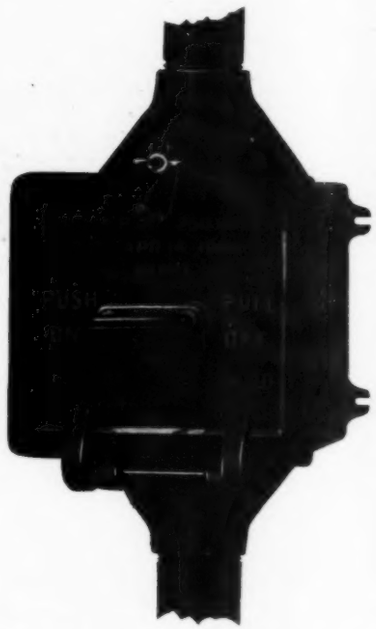


FIG. 1.—NEW TYPE OF SERVICE BOX.

Figure 1 shows the outside view, and it is noted that the box is threaded for conduit, and is provided with enlarged ends doing away with bending of wires, and allowing plenty of room in wiring.

The box can be sealed preventing tampering, yet the switch mechanism can be instantly controlled by means of the handle, as shown in the cut. Hinges, plunger rods, and wing nuts are of brass, preventing rusting, and the cover is provided with a gasket, giving a water tight construction.

Figure 2 shows the inside construction of a triple pole box. It will be noted that the outside legs are fused for National Electrical Code cartridge fuses, while the neutral leg is connected directly across the terminals. Also the terminals are of the solder lug type,

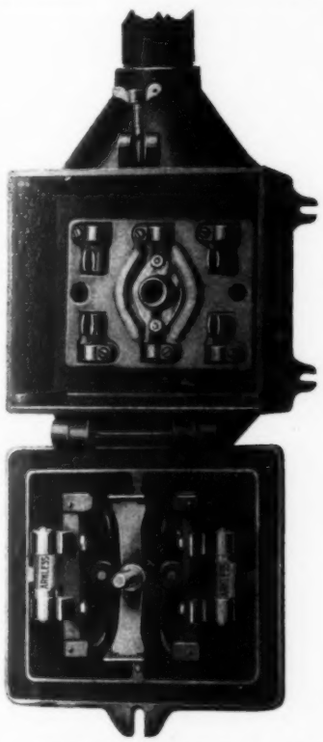


FIG. 2.—INSIDE CONSTRUCTION OF SERVICE BOX.

and sufficiently large to take No. 2 wire. It is impossible to make or break the circuit by opening or closing the cover, so that the switch must always be operated by means of the quick make and break mechanism.

Mine Inspectors' Convention.

The annual convention of the Mine Inspectors of the United States will be held in Chicago, Ill., June 9 to 15. In view of the action being taken to prevent repetitions of recent mine disasters, it is expected that the subject of electricity will receive a great deal of attention.

James Taylor, of Peoria, Ill., is chairman of the arrangement committee.

Chicago Wire Grip.

To meet the increasing demand, Mathias Klein & Sons, 566 West Van Buren Street, Chicago, Ill., have added to their regular line of Chicago wire grips, one suitable for handling No. 10 insulated wire. The peculiar feature

CHICAGO GRIP FOR NO. 10 INSULATED WIRE.

of this grip is the construction of the upper or sliding jaw. By reference to the enlarged cut, it will be seen that it is divided up into intermittent flat spaces and transverse grooves. The effect on the wire is such that the pressure due to the pull causes a slight depression in the insulation where in contact with the flat spaces, and presses it slightly into the transverse grooves just sufficient to grip tightly and prevent slipping without injuring the insulation in the least. The lower jaw is simply provided with a longitudinal groove, having an extension lip along its side as a firm support around a large part of the body of the wire. It is said by users of this grip, that it is giving entire satisfaction, and the manufacturers say they are receiving many repeat orders.

A noteworthy feature in all of the Chicago grips is the arrangement of the drawlink in a way that it does not

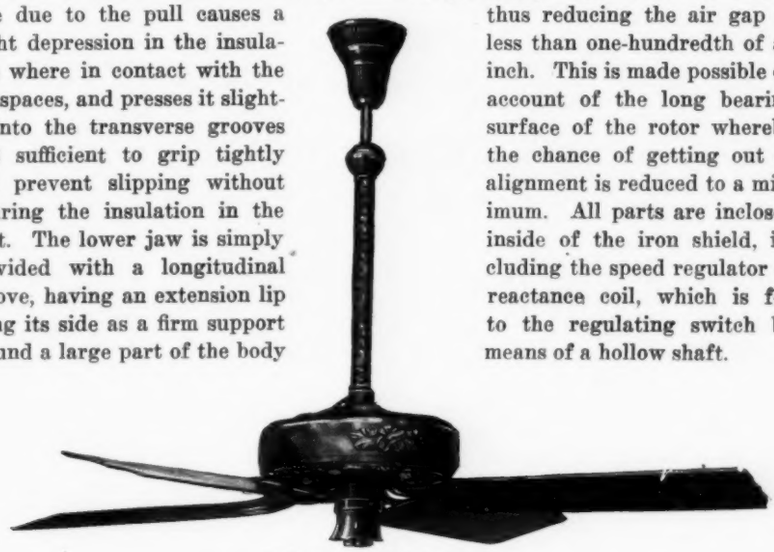
ENLARGED VIEW OF SLIDING JAW, CHICAGO WIRE GRIP.

hang down at right angles, and therefore is not in the way of the line wire when the grip is put on. The loop never drops below the horizontal position shown in the cut, but is free to move upward. This feature is appreciated when it is necessary to reach far out on the wire to put on the grip in pulling in slack.

"Tuerk" Fan Motors.

In the accompanying illustration is shown one of the new types of "Tuerk" ceiling fans being placed on the market by the Hunter Electric Company, 36 Vesey Street, New York, N. Y. This fan which is furnished complete with two-speed regulating switch, ceiling hook, canopy and insulated hanger, is of ornamental design and is equipped with an adjustable suspension stem.

The construction of the motor of this fan embodies many commendable features. The field or stator of the motor consists of sixteen distinctive poles with a corresponding number of poles on the rotor. The high efficiency obtained in the type CO construction is largely increased on account of the close proximity of the rotor to the field, thus reducing the air gap to less than one-hundredth of an inch. This is made possible on account of the long bearing surface of the rotor whereby the chance of getting out of alignment is reduced to a minimum. All parts are inclosed inside of the iron shield, including the speed regulator or reactance coil, which is fed to the regulating switch by means of a hollow shaft.



"TUERK" CEILING FAN.

The starting and regulating switch is imbedded into the bottom frame, so that the motor, for the purpose of installing, can be placed substantially on a bench by simply removing the switch button and in that way not injure the switch mechanism.

Each coil is tested at every point and the rotor is started up by a remote switch; this does away with extra starting torque and it is claimed that the consumption of current is thereby made less than in other types of ceiling fan motors.

The New York Telephone Company has leased ten floors of the Havemeyer Building at No. 26 Cortlandt Street, New York city. The lease is for a term of three years, and the company pays an annual rental of $107,788.

Current Electrical News

GREAT BRITAIN.

(Special Correspondence.)

LONDON, MAY 7.—For many years the Bournemouth tramway system was looked upon as a model, consisting as it does of conduit in the narrow streets of the center of the town, and overhead trolley in the outer and wider thoroughfares. London, in a mild degree, has copied Bournemouth's example, the operation of changing over from one system to the other occupying but a few seconds. Unlike London, however, Bournemouth has to depend largely upon summer holiday traffic, and during the past few years, through bad weather, coupled with a greater inclination on the part of visitors to walk, the financial position has become badly deranged. There was a thorough clearout of the old staff a year or two back, but the improvement still lags. Apparently, in a desperate effort to recover the lost position, the tramway manager now proposes to replace the conduit system by overhead throughout, and estimates that there will be a saving in running expenses of $15,000 per annum.

The phenomenal success achieved by the single-phase line of the London, Brighton & South Coast Railway Company in the south of London, and the complete recovery of lost traffic due to tramway competition, has encouraged the company definitely to undertake large extensions of the system. These include some twenty miles of road, and it may be that the decision has been accelerated by the probable promotion of a scheme in the next session of Parliament for the construction of a tube railway to the Crystal Palace, a spot included in the extensions of the single-phase line referred to above. At the same time, extensions were foreshadowed at the annual meeting of the railway company a few months back, and there is no doubt that the success of the single-phase experiment has exceeded anticipations.

A little better showing is made by the report and accounts of the British Westinghouse Company for 1909, despite the fact that there is a loss of $4,000. But this is after setting aside about $35,000 for depreciation of machinery, $50,000 for general depreciation, and meeting the six per cent and four per cent mortgage interest.

During 1909, 7,669 telephones were added to the postoffice system in London, making a total of 60,000 lines. These are, of course, quite independent of the National Telephone Company's system, active preparations for the taking over of which at the end of next year are now in hand.

For the past two or three years complaints have been very common as to the quality and attainments of the men usually put in charge of colliery electrical installations. The general opinion of the manufacturers of the plant is that practically all the accidents due to electrical plants underground are the result of carelessness and want of technical knowledge on the part of the men in charge.

S. G. Brown, the inventor of the famous submarine cable relay, has just patented a telephone relay, which he has demonstrated possesses some remarkable properties. It will magnify the very feeblest telephone currents, speech or signals too faint to be heard in the ordinary Bell receiver being heard clearly through the relay. In wireless telegraph work it has detected messages, the very existence of which was not even suspected. The principle of the instrument has also been applied to an electrical stethoscope. By means of an automatically regulated metal contact he has devised a most delicate microphone, more sensitive, there is every reason to believe, than could be found by light pressure between carbons. Osmium-iridium is the metal used, and the adaptations of it in a powdered form to a telephone transmitter has also brought some good results. G.

CONTINENTAL EUROPE.

(Special Correspondence.)

PARIS, MAY 5, 1910.—In France, the Southern Railroad Company, which operates one of the leading railway systems in the country, is taking measures towards adopting electric traction. For the present, this is to be applied upon a section of the line which runs from Pau to Montrejeau, in the Pyrenees region. Experiments will be first made with a type of electric locomotive which the company recently ordered from the Paris works of the Thomson-Houston firm, and it is designed to take passenger or freight trains of heavy tonnage, running as high as 450 tons, not counting the locomotive. This latter weighs eighty tons. A speed of thirty to fifty miles an hour is provided for. Single-phase current at seventeen cycles and 11,000 volts is to be used in this case, and the locomotive carries a transformer which will lower the voltage for the motors. Two motors are mounted on the chassis, these being single phase motors with commutator and of a new type which has been recently designed for locomotive work. Such locomotives are to give 800 horsepower. Three of the axles are driven from the motors by crank coupling. Trials are to be made of the locomotive upon a special experimental section which the company is putting out between Villefranche and Marquixanes.

At the last congress of telegraph and telephone engineers belonging to state administrations which was held at Budapest in 1908 it was decided that the next congress would be held during 1910. Recently it has been decided to hold it at Paris, and the executive committee is making preparations for this occasion. Papers are to be read upon central exchange, telephone circuits, apparatus, long distance working and multiplex systems. Among these latter, Prof. Mercadier's new vibratory method will have the greatest interest.

In Austria there is a project on foot for a light electric railway for which the power is to be furnished by turbine plants in the region. The railroad line starts from the town of Frankenmarket, which is a station on the Vienna-Salzburg railroad, and it passes by Heidewald and Hamberg, ending at the locality of St. Georgen. This latter point will be a station on the projected line from Vöckelmarkt to Attersee. For operating the new projected line it is proposed to use the three-phase system, and the power line which comes from the hydraulic plants will be operated at 10,000 volts. The Traunfall and the Schwarzensee turbine stations are likely to be used for supplying the current. A. DE C.

EASTERN CANADA.

(Special Correspondence.)

OTTAWA, ONT., MAY 14.—The contractor for the enlarging and deepening for power purposes, of the upper section of the Beauharnois canal, Quebec, is C. E. Fraser, of New York.

The town council of Renfrew, Ont., has decided to submit a by-law to the rate-payers on May 21, for $82,000 by a debenture issue for the purchase and development of a waterpower system. Three water powers are to be purchased, the cost and development of which, it is estimated, will amount to $117,000. The amount may, perhaps, be exceeded.

The city council of Moncton, New Brunswick, has ratified an agreement with the street railway company operating in that city, to lease the civic lighting plant for a period of thirty-nine years. The company agrees to reduce the price of lighting, and to pay rental on the percentage basis with the minimum of $10,000 annually. The agreement is to be submitted to the ratepayers on May 27.

The Halifax Electric Tramway Company, of Halifax, Nova Scotia, which has been in operation since 1896, in addition to the street railway controls all the gas and electric lighting business of the city. Although Halifax is growing at a more gradual rate than most Canadian cities, yet the gross and net earnings of the company show steady improvement in every year. Up to 1904 the concern made a dividend distribution of five per cent. In 1905, the dividend was raised to six per cent, and this rate was maintained until the middle of 1909, when the present seven per cent payment was inaugurated. As the stock of the company is held almost entirely in the hands of investors, its market position is very strong.

The reconstruction of the Marconi Wireless Company's station at Glace Bay, Nova Scotia, has been entirely completed with all the latest improvements. This station, which was destroyed by fire in August last, has since the completion of the rebuilding operations, been at work for a fortnight and giving splendid results. The whole wireless system has now been re-established on an entirely new and improved basis. Simultaneous with the completion of the new Glace Bay station, comes the opening of the new station at Clifden, on the west coast of Ireland, in County Galway, which supersedes for trans-Atlantic transmission the one erected at Poldhu in Cornwall. The accident, that necessitated the complete reconstruction of the station at Glace Bay, and interrupted wireless communication during the past autumn and winter, gave the Marconi company the opportunity of building and equipping the Clifden station, in accordance with the latest advances in radiotelegraphy. This station as well as the Glace Bay terminus is thus provided with several alternative methods of transmission, making a complete breakdown an extremely remote contingency in the future. The area occupied at Glace Bay and at Clifden, is thirty-five acres; and at each there are steam engines at work giving an aggregate of some 11,000 horsepower. The transmitting aerial contains about 60,000 feet of wire, and the receiving aerial about 18,000 feet. W.

IMPORTANT DEVELOPMENTS.

(Special Correspondence.)

POWER PLANTS FOR INDIANAPOLIS.—The Terre-Haute, Indianapolis & Eastern Traction Company has purchased a majority of the stock of the Indianapolis Traction and Terminal Company, which owns the city street railway system and the Traction Terminal Station. It is said that the erection of the power station will be begun within a few weeks. The station will be erected on a plot of ground ten acres in extent, on the north side of West Tenth Street, immediately west of White River. Plans for the plant have been drawn already and the contract is to be let immediately. Hugh J. McGowan, president of the company, said he could not give an estimate of the cost of the power station, but ultimately it will have a capacity of 40,000 kilowatts.

SHORE LINE ROAD NEAR COMPLETION.—The trolley line which the Shore Line Electric Railway Company is building from Ivoryton, in Middlesex County, to New Haven, Conn., a distance of forty-two miles, is expected to be ready for public traffic by July 1. For over ninety per cent of the distance the road runs over private property, and the line, of standard steam construction, is adapted to fast speed. The catenary system is used in the overhead equipment. The power plant is located on the west bank of the Connecticut River at Saybrook Junction. Four vertical turbines, each capable of generating 1,500-kilowatt units, will be installed. Sub-stations will be located at Saybrook and Guilford. Carbarns have also been built at Saybrook and Guilford. In addition to passenger traffic the road will carry freight and express matter.

LIGHTING AND POWER.

(Special Correspondence.)

HIGGINSVILLE, MO.—The city proposes enlarging its electric light plant. P.

TYNDALL, S. D.—This city is planning a $20,000 electric lighting system. P.

POTEAU, OKLA.—The Poteau Electric Light and Water Company will erect a $15,000 plant. P.

PALMYRA, MO.—This city voted May 18 on a $35,000 bond issue for electric light plant and waterworks. P.

SYLVIA, KAN.—The Sylvia electric light plant has been sold to James Roberts for a consideration of $7,200.

LEWIS, IOWA.—The vote to issue bonds for $4,000 for the purchase of the electric light plant was defeated. C.

GRAND FORKS, N. D.—An ordinance has been passed providing $135,000 bonds for electric light, water works and paving. C.

MOTT, N. D.—Ed. Rustad, of Grand Forks, N. D., has the contract for the installation of an electric lighting system. C.

MARSHFIELD, WIS.—The Marshfield Brewing Company is contemplating installing electric power in their brewery here. M.

PELICAN RAPIDS, MINN.—Bonds for $5,000 for the purpose of operating the electric light plant by water power have been voted. C.

BAKER, MONT.—Hugh C. Twaddle, of Hecla, S. D., is considering the installation of an electric light plant with a capacity of 1,000 lights. C.

BEND, ORE.—Frank Robertson, president of the Bend Townsite Company, announces that his company will soon begin the installing of an electric light system here.

YELLOW SPRINGS, O.—The $7,000 electric light plant was recently put in operation and is now supplying power. There has never before been electricity in the city.

COLUMBUS JUNCTION, IOWA.—L. J. Highland, engineer, representing Chicago capitalists, is making a survey for a dam to be constructed in conjunction with a power plant. C.

HARTFORD, CONN.—The Hartford Electric Light Company is to increase its capital stock $600,000, making the total capital $3,000,000. The plant of the company is to be doubled.

JOHNSTON, S. C.—The town authorities have ordered the erection of an electric plant to furnish 6,000 or more lights for residential purposes, and to supply the town with twenty-five arc lights.

MIDDLETOWN, CONN.—The plans for the new power house of the Middletown Electric Light Company have been completed and work is under way. Two 100-kilowatt Westinghouse generators have been ordered.

NEILLSVILLE, WIS.—The Electric Light and Water Supply Company is to increase its capital stock to $30,000 and issue $100,000 of bonds, to be used in developing additional water power on the upper dam across the Black River. M.

PORTLAND, ORE.—The Hood River Light and Power Company, incorporated by John D. Wilcox, Wirt Minor and Robert Smith, all of Portland, has taken over the properties of the Hood River Electric Light, Water and Power Company for $115,000. A.

ORTONVILLE, MINN.—The Minnesota River Improvement and Power Company of Mankato, Minn., is arranging for flowage rights for the construction of dams here and at Redwood Falls and Lac qui Parle, Minn., to develop an aggregate of 25,000 horsepower. C.

FOREST GROVE, ORE.—The city council has decided on a uniform plan of street lighting. Every block throughout the city is to be illuminated with a forty-candlepower incandescent light. No provisions have as yet been made for illuminating the business section.

IRETON, IA.—The Ireton Electric Light and Power Company has closed a deal with a New York firm for a complete outfit for an electric light plant for this town, and it is expected the plant will be in operation about July 1. The company is composed of local business men.

JEWETT CITY, CONN.—The Ashland Cotton Company is now operating its plant by electricity from its new power station at Hopeville, which generates about 400 horsepower. This will enable the company to drive additional machinery which will be installed as soon as possible.

TRENTON, TENN.—The primary held a short time ago to vote on the question of buying the old electric plant owned by Keenan & Wade, carried by a majority of thirty-six. The price to be paid is $9,300. The regular election to float $2,000 in bonds to put in a plant occurred May 20.

PERTH AMBOY, N. J.—The Public Service Corporation will erect a power house in this city costing over half a million dollars. It will be used to generate current for light and power throughout Middlesex County. When in operation the new station will replace the power house in Metuchen.

GRIDLEY, CAL.—The city has taken over the electric light and power plant formerly owned by Robert Beebee. The city has, through the Beebee contracts, an agreement with the Pacific Gas and Electric Company for power for fifty years. Power is taken in from a 15,000-volt transmission line.

NANT-Y-GLO, PA.—The Nant-y-Glo Light, Heat and Power Company, capitalized at $5,000, has just received its charter. The incorporators are H. E. Conrad, J. J. Conrad, T. P. Burns, J. F. Conrad, Edwin Smith, and M. B. Nairn. The company has been lighting Nant-y-Glo for the past three months. Incandescent lights are used.

FLORENCE, S. C.—The Florence Electric and Utility Company has been chartered by the secretary of state with a capital of $100,000. The company will furnish light and power to the city and citizens of Florence and will operate a waterworks system. The officers of the company are: Andrew P. Maloney, president; P. A. Willcox, vice-president, and L. C. Titchie, secretary and treasurer.

INDIANAPOLIS, IND.—The competition between the Indianapolis Light and Heat Company and the Merchants Heat and Light Company in placing lighting schemes in the down town streets has resulted in placing some lights side by side. Where the standards are not uniform the Board of Public Works has interfered declaring that the lights in each particular square must be uniform. S.

CRAWFORDSVILLE, IND.—The citizens of Crawfordsville have voted to issue $82,000 worth of bonds, the proceeds to be used in the construction and installation of a new electric light and power plant. The city has $40,000 on hand which together with the bond issue will provide for a plant to cost $125,000. Bids will be solicited for the installation of the new plant as soon as the bonds are sold. S.

SCRANTON, PA.—Capacity of the hosiery mill of H. A. Romberger, at Newport, is to be about doubled by the construction of an addition to the present mill, and also a dye-house. The proprietor will install a 100-horsepower Corliss engine, two 100-horsepower horizontal boilers, two electric generators, two electric motors for direct-current and the necessary dyeing machinery for sulphur black and colored work.

DOVER, DEL.—The Standard Gas and Electric Company of Philadelphia has been chartered with a capital of $24,000,000. The incorporators are Joseph P. Murray and Edgar E. McWhithy of Philadelphia. The concern is empowered to manufacture and generate electricity and gas for heating, power and light purposes. The company is one of the largest ever incorporated in Delaware. The State tax on the charter was $1,300.

BRISTOL, TENN.—The Doe River Light and Power Company has given the contract to the Lowe Construction Company to build the new dam across the Watauga River at Horseshoe Bend, in Carter County, the dam to cost $250,000 and the work to be completed within twelve months. The new company has contracted to furnish power to the Bristol Gas and Electric Company to be distributed and sold in Bristol for manufacturing purposes. L.

CYNTHIANA, IND.—The special election held at this place to decide whether to install an electric light plant, resulted in a big majority in favor of the improvement. The current will be supplied by the generating plant at Poseyville, a distance of four miles. Farmers living along the proposed line as well as townspeople are preparing to take service when the plant is completed. S.

MIDDLETOWN, CONN.—In the Middlesex County Superior Court Judge Williams has granted the application of Samuel E. Elmore, of Hartford, as trustee, for the foreclosure of a $50,000 mortgage on the property of the Salmon River Power Company. The time limit for the redemption of the property was fixed at June 15. The company operates a light and power plant at Lees-

ville. It is expected that the foreclosure proceedings will result in the reorganization of the concern.

NEW CONCORD, O.—At a meeting of the village council the contract for the construction of an electric light plant at New Concord was awarded to Fairbanks & Morrison, of Columbus. The contract price is $10,200. Construction work will be started at once, but it will require several months to install and equip the plant. The town will be illuminated with fifty arc lights, and an effort will be made to light all the business houses and many of the residences with incandescent lights.

DENVER, COL.—The Northern Colorado Power Company at a meeting of directors recently authorized the immediate construction at a cost of $250,000, of a new power transmission line between its plant at Lafayette and Greeley, and inaugurated plans for other extensive improvements. The new transmission line is to take in Fort Lupton, Brighton and all towns along the Union Pacific. A line now being built in this direction from Evans is to be continued on toward the power plant along the route of the Denver, Laramie and Northern railroad.

SAN BERNARDINO, CAL.—The Victor-Virgin power plant, at Needles, which has not been in use for several years, is about to be put in shape to furnish power to mines and for other purposes. Charles H. Burlock of San Diego recently paid Needles a visit to look over the power plant with a view of sending the electric current to the Mossback mines in the San Francisco district. Mr. Burlock in connection with others contemplates using the entire Victor-Virgin equipment, including the power plant. They will require 300 horsepower for their own use and will have a surplus of 300 horsepower to sell.

LYLE, WASH.—Fred Forrest, formerly connected with the S., P. &. S. Railway, has negotiated an option on the Klickitat Light and Power Company property. The consideration of purchase is to be $50,000, of which $500 has been paid on the option. The company now furnishes electricity for lighting Goldendale and nearby farms. The power house is located on the Little Klickitat, four miles directly east from Wahkiacus on the railroad. Engineers are now engaged in estimating the extent of undeveloped power owned by the company. The plant was installed about six years ago by the present chief owner, H. W. Fellows.

INDIANAPOLIS, IND.—Plans are under way for the erection of a new power plant in Indianapolis for the Terre Haute, Indianapolis and Eastern Traction Company at an estimated cost of $1,000,000. The new plant will supply power for the interurban lines only. The number of cars on the road has been largely increased of late on account of the heavy traffic and in many instances the strain has been too great on the plants now operated. All of the present power plants, however, are to continue as the new plants will be merely additional. With the new plant it is expected to have enough power to meet any emergency.

AVON, N. Y.—The entire capital stock of the Livonia Light and Heat Company, which has for several years been furnishing light and power to the village of Livonia, has been sold to a syndicate composed largely of men who are owners of the controlling interest of the Avon Electric Company. The new owners held a stockholders' meeting at which the following officers were elected: President, C. W. Richardson, of Bath; vice-president, Gurney E. Lott, of New York city; secretary, C. N. Quinby, of Rochester; treasurer, E. D. Hamlin, of Avon. It is the plan of the new owners to build a transmission line from Livonia to the plant in Avon, to close down the Livonia plant and to rebuild and put the Livonia system into first-class condition. As soon as the transmission line is completed the towns of Avon and Livonia will be given twenty-four hour service.

SAN FRANCISCO, CAL.—The most recent and one of the largest hydroelectric developments in this state, has just become public with the awarding of a contract to Allis-Chalmers Company by the Northern California Power Company for the initial installation of machinery. The contract calls for all the machinery and accessories and will include the following: three 7000 horsepower 450 revolution per minute single horizontal turbines with cast iron spiral casings. The runners are fifty inches in diameter and the gate valves forty-two inches in diameter. These turbines are each connected to a 5000-kilovolt-ampere, 6600-volt, sixty-cycle, three-phase alternator. Excitation current will be supplied by either of two 220-kilowatt, 120-volt generators direct connected to 350 horsepower 525 revolution per minute single impulse turbines controlled by type "O" governors. The turbine will operate under a head of 450 feet.

CHICAGO, ILL.—Arbiters are to be appointed to settle the dispute between the Avondale property owners and the Commonwealth Edison Company over the damage that will result to property through the laying of switch tracks to connect the two divisions of the company's proposed $20,000,000 plant. The tract is nearly two miles long, extending from the river to Kimball Avenue and north from Roscoe Street to Addison Street. In the center is the residence district, in which are several hundred homes. The local industries committee decided to have the Corporation Counsel's office draft an agreement by which the property owners may appoint an arbiter, the company another and these two a third. William G. Beale, attorney for the company, said the company was willing to treat the property owners fairly.

ELECTRIC RAILWAYS.

(Special Correspondence.)

CROWN POINT, IND.—Work has been resumed on the construction of an interurban line from Crown Point to Gary. The Aheborn Construction Company has the contract. S.

FRESNO, CAL.—The "Zepp's Park Franchise," for an extension of the street car system from Blackstone and Belmont avenues, to the Kings River, has been granted the Fresno Traction Company of this city. A.

PORTLAND, ORE.—The Coos Bay & Oregon Central Railway Company has been incorporated by C. F. Hendrickson, S. Connell, and J. H. Cole, all of Portland, with a capital stock of $4,000,000. A.

GLENDALE, CAL.—The Eagle Rock Railway has applied for a franchise for the extension of its present line, commencing at Glendale Avenue and Fourth Street, thence northerly along the east side of Glendale Avenue to the northern city limts. A.

PLYMOUTH, IND.—The Commissions of Marshall County have granted a franchise to Omer F. Neff of Nappenes for the construction of an interurban line from Bremen to the north county line. The proposed interurban line will connect Bremen and Mishawaka. S.

RALEIGH, N. C.—A movement is on foot, backed by citizens of this city and Cary, seven miles away, for the building of a connecting electric line. The Raleigh electric street railway is said to be behind the project, it also being proposed to construct a park about six miles out from Raleigh. L.

INDIANAPOLIS, IND.—The Board of Public Works has granted a franchise to the Beech Grove Traction Company to enter the city over LeGrande Avenue. This makes the second independent right-of-way granted to interurbans to enter the city—the other ten lines enter on the local street railway lines. S.

ATLANTA, GA.—In the tax returns made by the Georgia Railway and Electric Company an increase of over $250,000 in valuation is shown, the total valuation being placed at $8,338,000, of which $3,670,000 represents the value of the franchise held. The gas company is returned at $1,000,000, of which $600,000 represents the franchise valuation. L.

OMAHA, NEB.—The Omaha and Council Bluffs Street Railway Company has placed an order with Allis-Chalmers Company for a 3,750-kilovolt-ampere, twenty-five-cycle, 13,200-volt, three-phase steam-turbine generator. This will be installed in the power house in this city and beside relieving the present overload will help to provide for future business.

INDIANAPOLIS, IND.—The Terre Haute, Indianapolis & Eastern Traction Company has filed an $8,000,000 mortgage in favor of the Fidelity Trust Company of Philadelphia. The mortgage reduces the debt of the company $2,000,000 and grows out of the recent taking over by the company of the Indianapolis Traction and Terminal Company and merging it with the interurban system. S.

DETROIT, MICH.—For the first time since the committee of fifty started the street railway investigation early in 1909, the officials of the Detroit United Railways has made public the amount they claim its property is worth as a going concern. The figure is $20,532,676.43, and is arrived at by the officials by taking eighty-two and one-half per cent of the reproduction value of the property as found by the appraisal made for the company by Bion J. Arnold. The detailed figures of the company's claim are given out in a bill of particulars which Judges Murfin, Grant and Taylor of the court of arbitration asked the officials to furnish.

AUSTIN, TEXAS.—At the annual meeting of the stockholders of the Austin Dam and Suburban Railroad Company held here, the following officers were elected for the ensuing year: T. J. Freeman, president; P. J. Lawless, vice-president, secretary and treasurer; N. A. Stedman, P. J. Lawless and J. E. Lucy, directors. This road is owned by the Gould interests. Mr. Freeman, who was elected president, is at present receiver and general manager of the International and Great Northern. The road was recently rehabilitated and it is reported that it will be either leased to the Austin Electric Railway Company or will be operated as an independent electric line. It runs from the center of the city to the site of the former dam and lake resort on the Colorado River, a distance of about five miles. D.

WASHINGTON, IND.—The Vincennes, Washington and Eastern Traction Company has filed articles of incorporation with the Secretary of State. The capital stock is $100,000, divided into 1,000 shares of the par value of $100 per share. One-third of such capital stock shall be preferred stock and two-thirds thereof common stock. The object of the company is to construct, equip, rent and operate street and interurban railroads in Indiana and especially street and interurban lines within the City of Vincennes, Indiana, Washington, Indiana and Loogootie, Indiana connecting the said cities and other towns; to construct and operate power plants and substations for the creation and distribution of electricity for heat, light and power. The principal office of the company shall be in Washington, Indiana. Austin F. Cable Samuel C. Eskridge, Arnold J. Padgett, J. L. Ebiner, Jno. B. Seal and Elmer J. Binford are the incorporators. S.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

MARCELLUS, N. Y.—The Navarino Telephone Company has been incorporated with a capital of $5,000. The incorporators are Irving Rathbun, Fred Kinyon and W. C. Fisher.

FREEPORT, ILL.—The Freeport Telephone Company has been incorporated to operate a system of telephone lines. The capital is $50,000 and the incorporators are: R. K. Farwell, F. M. Gund and R. R. Tiffany.

KANSAS CITY, MO.—At a recent meeting of the stockholders of the Missouri and Kansas Telephone Company it was unanimously voted to authorize an increase in the capital stock from $5,000,000 to $20,000,000.

TRENTON, N. J.—The Autophone Company, of Stockton, Hunterdon County, was recently chartered by Secretary of State Dickinson. The company is capitalized at $40,000 and will conduct a telephone business.

WAUTOMA, WIS.—The Wautoma-Mount Morris Farmers' Telephone Company has been organized here with a capital stock of $10,000. The company will build an extensive rural system, which will connect with Wautoma. M.

MIDDLESEX, N. C.—The Middlesex Telephone Company is incorporated by N. B. High of Middlesex, and S. C. Wells, of Wilson, N. C., to build and operate a telephone line between the two towns named, the capital being $1000. L.

NEW ORLEANS, LA.—The Cumberland Telephone Company has a force of hands at work installing the system and exchange in Tylertown. The construction superintendent says that the work will be finished and ready to put in operation on or before June 1.

COOKEVILLE, TENN.—The Cookeville Home Telephone Company has been incorporated with a capital of $5,000. The incorporators are V. E. Bockman, J. T. Shirley, W. C. Maxwell, S. D. Davis, J. S. Lewis, W. F. Tulley, W. L. Huddleston, R. A. Elrod and W. R. Poston.

GOSHEN, IND.—Plans have been completed by the Horne Telephone Company of Ft. Wayne for the construction of a new toll line to connect Ft. Wayne, Ligonier and Goshen. When completed independent connection will be possible between Ft. Wayne and Chicago. S.

MAIDEN, N. C.—The Piedmont Telegraph and Telephone Company, operating lines in Gastonia, and other towns, has opened an exchange at Maiden, N. C., with sixty-five phones, of which forty are rural phones. J. A. Shuford, manager of the exchange at Lincolnton will also manage the new exchange at Maiden. Much attention is being given to the development of the rural telephone throughout this territory by all companies doing business in the Southeast. L.

DALTON, GA.—The local telephone exchange in Dalton is working with the Murray county company to secure connections with practically every important community in the county. The Dalton Company will run a line to Spring Place, while the Murray county company is building lines to Ramhurst, Eton, Chatsworth, and numerous other small villages and communities, most of these being toll lines at present. The telephone promoters, however, declare that eventually the toll system will be discontinued, and the exchange system will be put into use connecting the town and county. L.

ALBANY, N. Y.—The New York Telephone Company has filed with the secretary of state a certificate increasing its capital stock from $100,000,000 to $125,000,000. Of the existing capitalization, there has been issued $85,672,800. Ford Huntington, treasurer of the company, certifies that all the stockholders consented to the increase in the stock, and gives the following list of all shareholders in the New York company: U. N. Bethell, John H. Cahill, Benjamin E. Chase, John W. Griggs, Edward J. Hall, James H. Manning, J. F. Maynard, William Nottingham, William D. Sargent, Howard F. Thurber, Theodore N. Vail, Equitable Trust Company of New York, successor by merger to the Bowling Green Trust Company as trustee under an agreement between the Western Union Telegraph Company and the Bowling Green Trust Company; Henry M. Watson, William H. Woolverton.

ELECTRICAL SECURITIES.

The attention of the market has been closely directed to England during the past week, to see what would be the consequence of the death of King Edward.

The calmness of the English market inspired a feeling of satisfaction and confidence and this lay at the foundation of the week's improvement. The assumption that political difficulties in England would be adjourned to a future settlement was a material factor in alleviating the shock of the passing of the sovereignty. The metal markets received most consideration in the effort to discern the trend of business. The April copper statistics showed a large addition to surplus stocks, but the market was more responsive to reports of some large sales and to the advance in the price. Iron production continued to decrease and the price of iron receded further.

At the annual meeting of the stockholders of the General Electric Company, C. P. Hamilton, of New York, was elected to the board of directors to fill the vacancy caused by the resignation of W. M. Crane. No other business of importance was transacted.

H. M. Byllesby & Company, of Chicago, announce the calling at 101 and accrued interest on or before June 11, 1910, of the six per cent gold notes of the Enid Electric and Gas Company, of Enid, Okla. The American Trust and Savings Bank, of Chicago, will pay for the same on presentation.

Kings County Electric Light and Power Company earnings for the month of April were the largest in the history of the company, exceeding by a comfortable amount the record-breaking earnings of March. The exact figures are not yet ready for publication. Application has been made to the New York Stock Exchange to list $2,500,000 six per cent convertible debenture bonds, due 1922, of the Kings County Electric Light and Power Company.

DIVIDENDS.

American Railways Company, regular quarterly dividend of one and one-half per cent, payable June 15 to stock of record May 31. Books close May 31 and reopen June 3.

Brooklyn Rapid Transit Company, quarterly dividend of one and one-fourth per cent, placing the stock on a five per cent per annum basis, an increase of one per cent per annum. The initial dividend of one per cent was declared in February, 1909. The dividend is payable July to stock of record June 9.

Brooklyn Union Elevated Railroad, an initial dividend of five per cent on the common stock, and the regular semiannual dividend of two and one-half per cent on the preferred stock; the common dividend payable June 10 to stock of record May 31; the preferred payable June 30 to stock of record June 23.

Citizen's Traction Company (Oil City, Pa.), three per cent, payable May 16.

Columbus Railway Company, quarterly common dividend of one and one-fourth percent, payable June 1.

Georgia Railway and Electric, common quarterly dividend of one and one-half per cent, payable May 20.

Kellogg Switchboard and Supply Company, quarterly dividend of two per cent, and an extra dividend of one per cent.

Kings County Electric Light and Power Company, quarterly dividend of two per cent, payable June 1.

Mohawk Valley Company, initial dividend of one and one-half per cent, payable June 1.

Northern Ohio Traction and Light Company, quarterly dividend of one-half of one per cent, payable June 15.

Philadelphia Electric Company, quarterly dividend of one and one-half per cent, payable June 15.

NEW YORK.

	May 16.	May 9.
Allis-Chalmers common	9½	9¾
Allis-Chalmers preferred	33	35
Amalgamated Copper	71¼	66
American Tel. & Cable	*80	*80
American Tel. & Tel.	136¾	134¾
Brooklyn Rapid Transit	80¾	78⅝
General Electric	149½	146½
Interborough-Metropolitan common	21	20⅝
Interborough-Metropolitan preferred	56½	54¼
Kings County Electric	125	129
Mackay Companies (Postal Telegraph and Cables) common	89	85
Mackay Companies (Postal Telegraph and Cables) preferred	75½	75½
Manhattan Elevated	135	132
Metropolitan Street Railway	*18	*18
U. S. Steel common	83⅜	81⅞
U. S. Steel preferred	118	117
Western Union	68	68½
Westinghouse common	63	62
Westinghouse preferred	110	110

*Last price quoted.

BOSTON.

	May 16.	May 9.
American Tel. & Tel.	136¾	134¾
Edison Elec. Illuminating	250	249
General Electric	149½	146½
Massachusetts Electric common	18¼	18
Massachusetts Electric preferred	86	83½
New England Telephone	134½	133
Western Tel. & Tel common	15½	15
Western Tel. & Tel. preferred	87	83

PHILADELPHIA.

	May 16.	May 9.
American Railways	45	44¾
Electric Company of America	11⅞	11¾
Electric Storage Battery common	59½	59
Electric Storage Battery preferred	59½	59
Philadelphia Electric	15¼	15
Philadelphia Rapid Transit	19	17
Philadelphia Traction	85	83
Union Traction	48	44

CHICAGO.

	May 16.	May 9.
Chicago Railways, Series 1	98	98
Chicago Railways, Series 2	28	28¾
Chicago Subway	2⅝	2⅝
Chicago Telephone	115½	119½
Commonwealth Edison	113	113
Metropolitan Elevated common	18	15
Metropolitan Elevated preferred	57	56
National Carbon common	108¾	108
National Carbon preferred	116	116

PERSONAL MENTION.

EDWARD L. DOWNS, whom the Chicago & Milwaukee Electric receivers have appointed general manager, was formerly president of the Oshkosh City Railway and manager of other western traction properties.

FRED W. NASON, of 39 Cortlandt Street, New York city, has been appointed by the American Conduit Manufacturing Company, Pittsburg, Pa., to look after its interests in the Metropolitan district. Mr. Nason succeeds V. C. Gilpin.

DR. WILLIAM H. TOLMAN, under commission of the National Electric Light Association, sailed for Europe last week. He will remain abroad for six months, investigating methods for the prevention of loss of life and limb in electrical plants.

B. T. LONGINO, formerly of Atlanta, Ga., has been appointed assistant superintendent of the Tacoma (Wash.) Railway and Electric Company. Mr. Longino is a graduate of Georgia Technical Institute, going from Atlanta to Boston to enter the employ of Stone & Webster who later placed him at Seattle, from which city he goes to Tacoma.

FRED H. ANDRUS, who was recently elected superintendent of the municipal lighting plant of Burlington, Vt. assumed his duties on May 5. For the past twelve years Mr. Andrus has been superintendent of the Barre & Montpelier electric road, at Barre, Pa., and previously he was for two years superintendent of the local Military Post road.

EDWARD L. DOWNS, formerly president of the Oshkosh City Railway Company, and at one time general manager of the Petaluma and Santa Rosa Railroad, was appointed general manager of the Chicago and Milwaukee Electric Railroad by the receivers of the company. For the last two years he has been vice-president and general manager of the Lee County Lighting Company and the Sterling and Dixon Electric Railroad Company.

OBITUARY.

DAVID SULLIVAN, chief dividend clerk in the treasurer's office of the Westrn Union Telegraph Company, at No. 195 Broadway, New York city, died recently at his home, No. 53 East Eighty-seventh street. He had been in the employ of the Western Union for thirty-six years and was fifty-three years old.

CHARLES FRANCIS STONE, who was intimately connected with the development of the Edison electric light and the elevated railroads, died in California a short time ago. Mr. Stone was born in New York in 1834, and after graduation from Harvard University, became connected with the law firm of Porter, Lowrey, Soren & Stone. Later he became a member of Lowrey, Stone & Auerbach. Mr. Stone's body was brought from California and the funeral was held at All Saints' Church, New York city.

LEGAL NOTES

REQUIREMENTS IN REGULATIONS OF CHARGES.—A regulation of the charges for such service as the furnishing of electricity to the public, the Supreme Court of Arkansas says, in Little Rock Railway and Electric Company vs. Newman, 120 S. W. R. 824, should be just to the company as well as to all its patrons, so as to allow compensation to the former and reasonable, uniform rates to the latter, according to the amount of the commodity consumer. One class of patrons should not be favored at the expense of another. And the court does not hold that a regulation of charges, based exclusively on the number of units of the commodity consumed, would not be sustained if found to be just to the company and all its patrons.

WHAT CONSTITUTES "BUSINESS SERVICE."—A franchise owned by a telephone company provided for certain maximum rates for business service within a certain radius. The court of appeals of Kentucky holds, in the case of the East Tennessee Telephone Company vs. City of Harrodsburg, 122 S. W. R. 126, that the words "business service" mean the ordinary business service between the business men and other citizens within the radius specified. An agent and representative of a telegraph company could not obtain for his personal use a telephone and then as agent of the telegraph company use the telephone for the purpose of nullifying a contract between the telephone and telegraph companies providing for a joint traffic arrangement and the prorating of the cost of messages transmitted by them.

PROPOSALS.

POST OFFICE, GRIFFIN, GA.—The office of the Supervising Architect, Washington, D. C., will receive bids until May 25 for the construction, complete (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the United States Post Office at Griffiin, Georgia, in accordance with drawings and specification, copies of which may be obtained of custodian of site at Griffiin, Ga., or at the Supervising Architect's office.

ELECTRIC SYSTEM, FORT CASWELL, N. C.—Sealed proposals for furnishing and installing electric power plant and electric lighting system will be received until May 25, and then publicly opened. Information furnished upon request. Plans and specifications may be obtained upon deposit of $10, to guarantee return. Envelopes containing Proposal should be marked "Proposal for Electric System" and addressed to First Lieut. W. R. McCleary.

LIGHTING SYSTEM, FORT MORGAN, ALA.—Sealed proposals will be received until May 23 for the construction of an electric lighting system at Fort Morgan, Ala. Plans, specifications, blank proposals and further information furnished on application. A deposit of $10 is required for drawings and specifications, deposit will be returned to the bidder upon return of drawings there. Plans and specifications may be seen at the office of the constructing quartermaster, also at the Bank of Mobile, N. B. A., Mobile, Ala. Proposals should be marked "Proposals for electric lighting system," and addressed to Captain H. B. Chamberlin, Quartermaster United States Army, Constructing Quartermaster.

NAVY REPARTMENT SUPPLIES.—The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will open bids on naval supplies on the dates given below. Bidders interested therein should make early application for copies of the schedule, giving the schedule numbers desired. Schedules can be obtained from the Navy Pay Office nearest each navy yard. Bids will be asked on the following supplies.

Date of Opening.	Material.	Quantity.	Place of Delivery.	Schedule No.
May 31—	Brushes, carbon	1,000	Brooklyn, N. Y.	2498
	Cable, steel, copper, clad.	12,000 ft.	Brooklyn, N. Y.	2498
	Tape, cotton insulating.	400 lbs.	Brooklyn, N. Y.	2498
	Wire, magnet	650 lbs.	Brooklyn, N. Y.	2498
	Motors, electric, 10 H. P.	2	Philadelphia, Pa.	2506
	Motors, induction	4	Norfolk, Va.	2506
June 7—	Crane, rotating pillar, electric drive, 10-ft. radius.	1	Hingham, Mass.	2491
	Motors, 2 and 3 H. P.	2	Norfolk, Va.	2518

NEW PUBLICATIONS.

THE PANAMA CANAL.—This booklet, which was published by the Isthmian Canal Commission contains drawings and descriptions of the work on the canal. Tables are inserted to show the appropriation and expenditures in relation to the work, and figures are also given on the equipment.

TESTS OF WASHED GRADES OF ILLINOIS COAL.—Under this title is issued Bulletin No. 39 of the Engineering Experiment Station, of Urbana, Ill. During the years 1906 and 1907 a series of steam boiler trials was undertaken by the Engineering Experiment Station under the general direction of Professor L. P. Breckenridge and with the cooperation of a Fuel Test Conference Committee composed of several distinguished Illinois engineers. A large number of tests involving the use of various sizes and grades of Illinois washed coal were made in connection with a Heine 210-horsepower water-tube boiler. The primary object of the tests was the comparison of various sizes of Illinois washed coal. The tests were carried on in such a manner as to facilitate study with reference to evaporative performance, capacity, rate of combustion, depth of fuel beds, and draft values. The description of the plant, the methods employed, and the results of the tests are given in detail. These results should be of interest to all engineers concerned with the use of coal for the production of power. Copies may be had upon application to W. F. M. Goss, director of the Engineering Experiment Station located at Urbana, Ill.

NEW INCORPORATIONS.

CAMDEN, N. J.—The Pittsburg Portable Electric Drill Company has been incorporated by J. A. MacPeak, G. H. B. Martin and I. C. Clow, of Camden, with a capital of $200,000.

CLEVELAND, O.—The Electric Specialty Company has been incorporated with a capital of $10,000, by R. L. Palmer, Edward Younger, H. J. Palmer, T. R. Tease and W. K. Caldwell.

KENYON, MINN.—The Kenyon Electrical Manufacturing Company, capital $125,000, has been incorporated by August Jensen, Martin Hjermstad and others, to manufacture electrical carrier systems, motors, batteries, etc. C.

STAMFORD, CONN.—A certificate of incorporation has been granted to the Standard Electric Fittings Company, capitalized at $20,000. The incorporators are Justus W. Hall, F. H. Anderson of Manchester and Leroy E. Hall of Rockville.

EAST ORANGE, N. J.—The Tungsten Lamp Repair Company has been incorporated to manufacture electric motors, dynamos, batteries, etc. The capital is $50,000, and the incorporators are: H. E. Verpollier, C. O. Geyar and F. E. Ruggles, East Orange.

INDUSTRIAL ITEMS.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., has printed its price list for May, 1910. A full line of electrical supplies with the prices and discounts is listed therein.

THE MINNEAPOLIS STEEL AND MACHINERY COMPANY, Minneapolis, Minn., is presenting to its patrons its May stock list, a little book of information which will find a place in any ready reference file. The company has a full line of catalogues covering the lines, which are mentioned on the back cover of this booklet, and will be pleased to send any of those desired.

THE ELECTRIC CONTROLLER AND MANUFACTURING COMPANY, Cleveland, O., recently issued its May number of

Common Sense. The booklet contains some very interesting matter relating to advertising.

THE TURNER-FRICKE MANUFACTURING COMPANY, Sharon, Pa., describes its Turner-Fricke gas engines in a booklet recently distributed to those interested in this type of engine. Each part of the engine is quite fully considered and numerous illustrations serve to make clearer the especial points of construction.

THE DAYTON ELECTRICAL MANUFACTURING COMPANY, Dayton, Ohio, recently made a large shipment of electrical outfits to Bangkok, Siam. The present shipment is the fourth made to Siam during the current year. One of the outfits in this shipment has been sold to his royal highness, Prince Y. Saintwoupse, of Bangkok.

THE WAGNER ELECTRIC COMPANY, St. Louis, Mo., recently issued bulletin No. 82 on the subject of polyphase motors. Some interesting features of the guarantees of Wagner motors are given, the point being made that it is more important to have surety of starting and dependability than a high theoretical efficiency. The bulletin is quite fully illustrated.

THE BALL & WOOD COMPANY, Elizabethport, N. J., has closed a contract to furnish the Illinois Steel Company, one of the constituent companies of the United States Steel Corporation, with two 2,000-kilowatt turbines. These are to be of the Ratean-Smoot, mixed flow type. Each turbine is to be directly connected to a 3,000-kilowatt, twenty-five cycle, 2,200-volt, three-phase, alternating current generator. The units are to be installed at the South Works, Chicago.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., is furnishing new power equipment for the plant of the National Lead Company at St. Louis, Mo. The contract for the apparatus includes two twenty by forty-two heavy-duty Corliss engines. One of these will be direct-connected to a 250-kilowatt, 240-volt generator and the other will be provided with a rope flywheel for driving shafting. In addition there will be a 100-kilowatt, 240-volt generator for direct connection to high-speed engine, fourteen 240-volt motors ranging from five to fifty horsepower, and a six-panel switchboard.

THE MINNESOTA ELECTRIC COMPANY, Minneapolis, Minn., is distributing booklets and cards relating to the Chapman lightning arrester. Attention is called to the mechanical construction of the arrester and the points are made clearer by a number of illustrations. A small folder touches on the importance of a proper ground connection and gives some valuable suggestions as to the way the ground should be made. A card which is enclosed with the booklet shows a picture of the Minneapolis city hall taken by the light of lightning flashes. The fire alarm lines in that building are protected by Chapman lightning arresters.

THE SPRAGUE ELECTRIC COMPANY, New York, N. Y., has recently mailed booklets to its customers on the subjects of flexible steel armored hose, and electric hoists. The booklet dealing with armored hose contains a number of illustrations showing some of the ways in which this hose is employed. A large amount of this hose was used in the excavation of the Pennsylvania railroad terminus in New York city. The bulletin which describes the electric hoists makes an especial point of this device as a means of cheapening and increasing production. Electric shovels and winches are also described. The Sprague company's 1910 bulletin on electric fans is an especially attractive one, and shows by means of numerous illustrations the complete line of fans which the company is placing on the market.

THE INTERNATIONAL ACHESON GRAPHITE COMPANY, Niagara Falls, N. Y., announces that in order to meet the demands of the trade more promptly, it has established three new branch offices. One of these in New York city is at 511 West Street Building. In Chicago an office has been opened at 457 Monadnock Block, with the object of caring for the middle-western trade. Business in and about Pittsburg will be looked after from the Pittsburg branch at 309 Fourth Avenue. The company also announces that it has adopted the name Gredag for its graphite grease in order that it may be distinguished from other grease products. The graphite blended with a high-grade grease in Gredag is an electric-furnace product—the purest in the world. As it is soft and unctuous, this graphite is a perfect lubricant in itself, but in Gredag are combined all the merits of both graphite and grease, the combination making a lubricant of high quality and value.

THE AMERICAN STEEL AND WIRE COMPANY, Chicago, Ill., has published as its main article in the May issue of American Wire Rope News, a description of the Detroit River tunnel. An account of the methods of construction used and the part that the steel cable took is given. Numerous illustrations give an excellent idea of the appearance of the tunnel. An article entitled "The Scientific Lubrication of Wire Rope" may be read with profit by any one using rope for hoisting or other purposes. Attention is invited to the revision of tensile strengths, also to new list prices which are shown. Beginning May 1, these new standard strengths and list prices will be used in lieu of the old strengths and lists. The method of measuring breaking strengths has heretofore been based upon the individual wires in the rope. For the first time the company has published the figures of breaking strengths based upon the average of the different sizes and kinds of wire rope as obtained by actual tests on a large number of specimens. These figures now represent the standard adopted by all makers of wire rope in the United States. In no case have the intrinsic strengths been reduced, the new method being adopted to meet the desire for more convenient and direct figures.

DATES AHEAD.

National Electric Light Association. Annual convention, St. Louis, Mo., May 23-28.

Maine Electrical Society. Next meeting, Portland, Me., May 25.

National Electrical Trades Association. Next meeting, San Francisco, Cal., June, 1910.

Mississippi Electric Association. Annual convention, Greenville, Miss., June 15 and 16.

American Institute of Electrical Engineers. Annual convention, Waumbeck Hotel, Jefferson, N. H., June 27, 28, 29 and 30.

Michigan Electrical Association. Annual convention, Port Huron, Mich., August 16, 17 and 18.

Colorado Electric Light, Power and Railway Association. Next convention, Glenwood Springs, Colo., Sept. 21, 22 and 23.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) May 10, 1910.

957,192. ELECTRIC BATTERY. Frank A. Decker, Philadelphia, Pa., assignor to Decker Electrical Manufacturing Company, Wilmington, Del. Filed June 20, 1907. Renewed November 11, 1909. The battery fluid may be forced into the battery from a tank.

957,193. PROCESS OF PREVENTING SURFACE OXIDATION OF RESISTANCE-CONDUCTORS. John T. H. Dempster, Schenectady, N. Y., assignor to General Electric Company. Filed March 20, 1909. The process of treating resistance conductors to prevent initial oxidation consists in applying thereto a readily oxidizable substance.

957,209. ELECTRIC GENERATOR AND MOTOR. Charles T. Hibbard, Minneapolis, Minn., assignor to Electric Machinery Company, Minneapolis, Minn. Filed July 24, 1908. A pole-piece has a laminated tongue fitting within and passing through a radial orifice in a solid-rimmed field spider.

957,213. COIL FOR ELECTRICAL PURPOSES. Elbert W. Jodrey, Lynn, Mass., assignor to General Electric Company. Filed October 26, 1905. Terminal conductors are stapled to a core of insulating material, and a conductor coiled about this core has its terminals secured to the terminal conductors.

957,222. APPARATUS FOR LOCATING SUNKEN VESSELS. George B. Lea Quee, Mount Iron, Minn. Filed May 17, 1909. An apparatus for the location of sunken vessels comprises a buoy made in two airtight compartments, electric lights located in separate watertight compartments, a weighted rocker and divided contacts for opening and closing the lighting circuit, and a flexible connection between the buoy and vessel.

957,223. DEVICE FOR OPERATING MOTORS FOR SEWING-MACHINES AND THE LIKE. William Lenhart, Cuyahoga Falls, Ohio. Filed December 31, 1909. A motor is mounted on a pivoted lever arranged for vertical oscillation on a supporting medium positioned adjacent a driven wheel. A friction wheel on the shaft of this motor is arranged when the motor is oscillated in one plane to be thrown into and withdrawn from operative engagement with the wheel, and a braking member is arranged to be moved into and out of operative engagement with the wheel alternately with respect to the engagement of the friction wheel therewith.

957,226. ELECTRIC HEATER. Judson C. Logan, Pittsfield, Mass., assignor to General Electric Company. Filed March 20, 1909. An electric heating unit comprises concentric spaced rings of insulation having two independent resistance conductors wound thereon adjacent to each other and having three terminals, one of which is common to both windings.

957,227. ELECTROPNEUMATIC AIR-BRAKE SYSTEM. George Macloskie, Schenectady, N. Y., assignor to General Electric Company. Filed February 1, 1910. Electromagnet means are provided for producing a variable pressure on one side of a movable member (for operating the valve mechanism) the other side of which is subject to pressure from the air-brake cylinder.

957,242. DYNAMO-ELECTRIC MACHINE. Jacob E. Noeggerath, Schenectady, N. Y., assignor to General Electric Company. Filed April 13, 1908. A dynamo-electric machine comprises an insulated pipe of comparatively small cross section near its center and flaring at the ends, a field magnet and winding adapted to produce a flux passing transversely through the pipe, and current terminals within the central portion of the pipe on opposite sides of the path of the flux.

957,249. DYNAMO-ELECTRIC MACHINE. William D. Pomeroy, Norwood, Ohio, assignor to Allis-Chalmers Company, and The Bullock Electric Manufacturing Company. Filed May 3, 1906. A ventilating collar for field magnets comprises a plate having integral lateral ribs on the sides, and a plurality of lugs on the inner surface.

957,256. ELECTRIC SOLDERING-IRON. Edwin W. Rice, Jr., Schenectady, N. Y., assignor to General Electric Company. Filed October 7, 1909. An electric soldering iron comprising an electrically heated soldering tip, a handle therefor having conducting terminals extending therethrough, and an enlarged portion adjacent to the tip for supporting it above the resting surface.

957,257. FILM-HOLDER FOR OSCILLOGRAPHS. Lewis T. Robinson and Robert Miller, Jr., Schenectady, N. Y., assignors to General Electric Company. Filed October 29, 1908. Positive variable speed gearing actuates two movable film holders in definite relation to each other and varies progressively the relative speed of these holders. A positive stop for one of the holders is shifted by the gearing into locking position at a definite point in the movement of the gearing.

957,261. ATTACHING-PLUG. Howard R. Sargent, Schenectady, N. Y., assignor to General Electric Company. Filed October 1, 1907. The plug has a recessed body divided into two chambers, a line terminal in each chamber, and a removable inclosed fuse in each chamber.

957,262. INTERLOCKING SWITCH. Arthur C. Savage, Schenectady, N. Y., assignor to General Electric Company. Filed January 28, 1909. A contact member yieldingly mounted on a rod that automatically moves longitudinally and sidewise with respect to a supporting member to which two fixed contacts are secured, is arranged to complete the circuit across the fixed contacts, and stops on the rod limit the movement of the contact member.

957,270. COMBINED MAGNETO AND BATTERY SWITCH FOR ELECTRIC IGNITERS. Albert J. Studnicka and Charles W. Campbell, Minneapolis, Minn. Filed November 18, 1908. An ignition mechanism for multicylinder explosion engines.

957,277. MOTOR-DRIVING MECHANISM. Louis E. Underwood, Lynn, Mass., assignor to General Electric Company. Filed June 22, 1906. The mechanism includes a machine comprising a wheel to be driven, an electric motor including a frame and a driving wheel, an annular member surrounding one of the wheels and engaged by both wheels, a support for the motor frame, and means tending to turn the frame to move the driving wheel toward the driven wheel.

957,287. RESILIENT LAMP-SUPPORT. Alfred Woodley, Montreal, Quebec, Canada, assignor to Universal Electric Economy Company Limited, Montreal, Canada. Filed January 3, 1910. A shock absorber for incandescent lamps.

957,290. DIRECT-CURRENT TURBO-GENERATOR. Edwin C. Wright, Newport, Ky., assignor to Allis-Chalmers Company, and The Bullock Electric Manufacturing Company. Filed November 30, 1906. A rotor for a dynamo-electric machine includes a core, an end member therefor provided with a radial flange adjacent to the core, coils carried by the core and projecting beyond one end of it through openings in the flange, and a ring surrounding the flange and the projecting portions of the coils, the ring and flange having interlocked parts which prevent axial movement of the ring.

957,300. CABLE-CLIP. Thomas J. Baugh, Hopkinsville, Ky. Filed July 16, 1909. A cable clip or band comprises a rectangular body having extension arms formed with terminal slots and oppositely pointed tongues formed in the body to engage the slots.

957,312. TELEGRAPHIC KEYBOARD TRANSMITTING APPARATUS. Patrick B. Delany, South Orange, N. J. Filed Feb. 5, 1906. Transmitting keys, one for each character or letter, are provided.

957,319. CIRCUIT-BREAKER-RETARDING DEVICE. Charles E. Eveleth, Schenectady, N. Y., assignor to General Electric Company. Filed May 25, 1904. A time-limit device is described.

957,321. BATTERY CHARGING AND DISCHARGING SYSTEM. Lothar Fiedler, Stoke Newington, London, England. Filed February 25, 1907. A device for automatically maintaining a storage battery in charged condition.

957,334. CIRCUIT-BREAKER. Clark T. Henderson, Milwaukee, Wis., assignor to The Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Filed July 1, 1909. A switch responsive to abnormal conditions causes the de-energization of an electro-responsive controlling switch, and an interlock between the switches prevents the return of the second switch to initial position when the first switch is open.

957,335. AUTOMATIC CIRCUIT-BREAKER. Charles T. Hentschel, Schenectady, N. Y., assignor to General Electric Company. Filed September 10, 1908. An automatic non-closable circuit-breaker comprises separable contacts, an operating handle, a collapsible toggle for connecting the handle and the contacts, a trip member operated by stored energy to collapse the toggle, an energy-storing operating device for the trip member and means whereby the movement of the operating handle to straighten the toggle stores energy in the operating device.

957,337. ELECTRIC FURNACE. Hiram W. Hixon, Philadelphia, Pa. Filed June 11, 1909. An electric zinc-smelting furnace.

957,371. ATTACHMENT FOR ELECTRIC-LAMP SOCKETS. Hugh E. Plunkett, Charlestown, Mass. Filed May 17, 1909. A globe holder attached to the socket has ventilating openings and a switch-operating chain is supported away from the globe by a bracket arm.

957,397. ELECTRIC ALARM-CLOCK. Horace C. Wilcox, Hazleton, Pa. Filed June 17, 1909. An electric circuit is controlled by the clock hands.

957,398. TIME-CONTROLLING MECHANISM. Horace C. Wilcox, Hazleton, Pa. Filed August 7, 1909. Comprises a support having bearings, an unbalanced tank, a band clamped around the tank, trunnions carried by the band and journaled in the bearings, means for holding the tank stationary, and time-controlled electromagnetic means for releasing the holding means.

957,403. TELEPHONE-RECEIVER. Nathaniel Baldwin, Heber, Utah. Filed July 1, 1909. A telephone receiver comprises a casing, a permanent magnet mounted therein, an apertured disk (through which the legs of the magnet pass) adapted to engage the casing, and a cap clamping the disk against the casing.

957,404. TELEPHONE-MOUTHPIECE. Anna Bebout, St. Louis, Mo. Filed March 29, 1909. A telephone attachment comprises an annular frame having inner and outer annular walls with a space between the walls, the outer annular wall being adapted to fit over and embrace a telephone mouth piece of one diameter and the inner annular wall being adapted to fit over and embrace a telephone mouth piece of a lesser diameter.

957,452. AUTOMATIC CIRCUIT-CONTROLLING DEVICE. William C. Yates and Walter O. Lum, Schenectady, N. Y., assignors to General Electric Company. Filed September 22, 1906. Means for controlling an electric-motor circuit comprise a plurality of electromagnetic switches in the circuit, an electrically controlled device for successively energizing the switches to affect the circuit, and connections whereby certain of the switches are each de-energized by the actuation of the next succeeding switch.

957,454. MOTOR CONTROL. Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Company. Filed August 10, 1907. In combination with a plurality of alternating current series motors connected in series, are connections for producing a phase-displacement between the voltages at the armature terminals of the motors, and connections including means for impressing on the motor fields a shunt voltage corresponding in amount to the phase-displacement.

957,489. TELEPHONE APPARATUS. Charles F. Bradburn, Delmer, Ontario, Canada. Filed August 10, 1907. A telephone system comprises a number of telephone instruments, a selecting instrument for each telephone instrument, a normally open local telephone circuit connecting each telephone instrument with its respective selecting instrument, a selecting circuit connecting the selecting instrument in series, a main telephone circuit connected through all the selecting instruments, and arranged to be closed by the selecting circuit through the local telephone circuits of any selected, two, telephone instruments, and an emergency circuit forming part of the main telephone circuit arranged to be closed through the signal set of the local telephone circuit.

957,490. TELEPHONE APPARATUS. Charles F. Bradburn, Delmer, Ontario, Canada. Filed January 20, 1908. A selecting instrument comprises a primary mechanism having a primary pointer and contacts engaged by the primary pointer, and a secondary mechanism controlled by the contacts having a secondary pointer, and means actuated by the secondary pointer controlling the movement of the primary pointer from its initial position.

957,491. TELEPHONE SYSTEM. Charles F. Bradburn, Delmer, Ontario, Canada. Filed November 25, 1908. A selecting instrument comprises a primary mechanism having a primary pointer and contacts engaged thereby, and a secondary mechanism controlled by the contacts having a secondary pointer and individual and common calling contacts, engaged by the secondary pointer.

957,505. ALTERNATING-CURRENT MOTOR. Valere A. Fynn, London, England. Filed June 12, 1909. A stationary member is

provided with a neutralizing winding, and a rotor with a commuted winding connected in series relation to the neutralizing winding by means of working brushes coaxially disposed with reference to the neutralizing winding.

957,506. ELECTRIC CABLE. Roderic F. Hall, East Orange, N. J., assignor to Western Electric Company, Chicago, Ill. Filed July 24, 1905. An electric cable is made up of insulated continuous wires twisted in pairs, each pair being twisted with a variable lay, and the several pairs being transposed with reference to each other at intervals in their continuity.

957,516. CURRENT-CONTROLLER. Burton H. Parker, Port Colburn, Ontario, Canada. Filed July 8, 1909. A contact member on a rotary device operates by centrifugal force according to the speed of rotation.

957,522. DYNAMO-DRIVING. William I. Thomson, Newark, N. J., assignor to The Safety Car Heating and Lighting Company. Filed September 1, 1909. Means for carrying a dynamo upon a car truck in operative relation to the axle comprises members attached to the upper side of the safety sills, members attached to the lower side of the safety sills, a transverse member supported between the members carried by the safety sills on each side of the truck and means for mounting the dynamo on transverse member below the armature.

957,528. ELECTRICAL SYSTEM OF DISTRIBUTION. William A. Turbayne, Lancaster, N. Y., assignor to Gould Storage Battery Company. Filed September 14, 1906. Comprises an alternating-current generator, a storage battery and means for operatively connecting the same to the generator, an alternating-current synchronous motor, an alternating-current induction motor having less poles than the synchronous motor, means for varying the sped of the latter responsively to changes of electrical condition of the alternating-current circuit, and regulating apparatus for the battery controlled responsively to relative speed variations of the two motors.

957,530. ELECTRICAL SYSTEM OF DISTRIBUTION. Walter E. Winship, New York, N. Y., assignor to Gould Storage Battery Company. Filed September 19, 1906. A distribution system for electric cars includes a battery floating on the line, etc.

957,534. PREPAYMENT ELECTRICITY-METER. Hermann Aron, Charlottenburg, Germany, assignor, to The American Aron Electricity Meter Company. Filed December 12, 1906. A coin-controlled vending machine comprises a supply member for establishing and interrupting the supply of the commodity to be delivered, a controlling member therefor adapted to maintain the same normally in initial cut-off position, actuating means for moving the controlling member from its initial position and including a rotary coin-receiving member and an independently movable propelling member adapted to engage a coin carried by the coin-receiving member to effect the rotation of the same, and means mechanically driven for returning the controlling member to initial position.

957,535. PREPAYMENT ELECTRICITY-METER. Hermann Aron, Charlottenburg, Germany, assignor to The American Aron Electricity Meter Company. Filed November 13, 1906. Renewed October 14, 1909. Comprises a rotary actuator adapted to be freely rotated by hand, a controller shaft, a controller member carried thereby, an intermediate shaft carrying a spring for turning the controller shaft, gearing connecting the spring with the controller shaft, a frictional driving connection between the actuator and its intermediate shaft, a let-off mechanism for the controller, a cam member for governing the let-off mechanism, and connections, brought into operation by introduction of a coin, between the actuator and the cam member.

957,547. ELECTRIC ROSETTE. James S. Crossley, Syracuse, N. Y., assignor to Pass & Seymour, Inc., Solvay, N. Y. Filed October 20, 1906. A one-piece porcelain body has a flat base and a hollow boss, the latter having a side opening for the passage of the knot, side notches formed in its walls for the conductor ends, a recess centrally to seat the knot and a passage from the recess for the depending conductors.

957,572. ELECTRIC DOOR-OPERATOR. Toich Nakahara, New York, N. Y. Filed February 2, 1910. Includes an electric motor.

957,578. CIRCUIT MAKE-AND-BREAK DEVICE. James E. Scovill, Chicago, Ill. Original application filed January 8, 1909. Divided and this application filed April 26, 1909. Contact is made and broken by a revolving four-armed star wheel with wedge-shaped ends, etc.

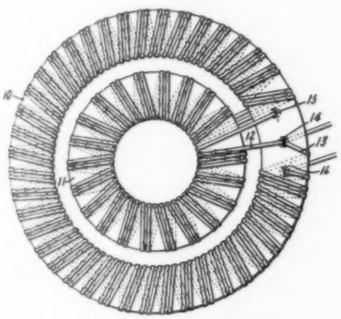
957,585. TROLLEY-GUARD. Frank B. Wagner, Cleveland, Ohio. Filed October 16, 1905. A guard for an electric-railway trolley.

957,587. STARTING DEVICE FOR ELECTRICAL MOTORS. Hans Weichsel, St. Louis, Mo., assignor to Wagner Electric Manufacturing Company, St. Louis, Mo. Filed June 17, 1908. A stationary member co-operating with a rotary handle (for actuating a rotary contact member) is provided with notches for determining the controller positions of the rotary member, etc.

957,662. MEANS FOR OPERATING MASTER-CONTROLLERS. Eugene G. Deucher, Cleveland, Ohio, assignor to The Brown Hoisting Machinery Company, Cleveland, Ohio. Filed July 28, 1909. Means for operating a plurality of master controllers comprise a suitable gearing for simultaneously rotating the controllers and a two-way or duplex hand-lever for actuating the gearing, when moved in one direction, and for making and breaking a contact with the circuits of the controllers, when moved in a cross-wise direction.

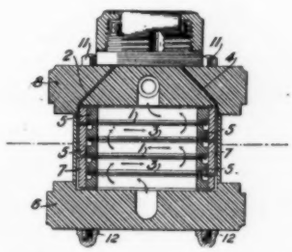
957,653. OIL-PROOF SPARK-PLUG. Eli J. Bushey, New York, N Y. Filed March 10, 1909. A spark-plug is provided with a shell having an exterior retaining flange at its terminal, and a firing cap forming with the shell a spark-gap, the cap having a deflecting flange at the gap.

957,667. APPARATUS FOR ELECTRICALLY HEATING RUNNING WATER. George Fuller and Leonard Fuller, Bow, London, England. Filed June 3, 1909. Comprises horizontally arranged superposed extremely thin platinum plates, each having a through aperture to permit of the passage of the liquid between and through the plates from the water-inlet to the water-outlet, edge clamps comprising frames, located in the casing to grip the edges of the plates betwen them and hold same at a distance apart, a negative electric terminal, an electric conductor extending from alternate platinum plates to the negative terminal, a positive electric terminal, and an electric conductor extending from the remaining platinum plates to the positive terminal.



957,226.—ELECTRIC HEATER.

957,506.—ELECTRIC CABLE.



957,667.—WATER-HEATING DEVICE.

957,668. ALTERNATING-CURRENT MOTOR. Valere A. Fynn, London, England. Original application filed December 19, 1906. Divided and this application filed March 6, 1909. A stationary member is provided with a neutralizing winding; a revolving member is provided with a commuted winding connected in series relation with the neutralizing winding; and means are provided for producing an alternating flux along an axis approximating coinciding with that of the neutralizing winding.

957,710. ELECTRIC SIGN. Edwin J. Prindle, East Orange, N. J., assignor to Vita Electric Sign Company, New York, N. Y. Filed November 24, 1909. An electric sign has a line of lights which are capable of movement independently of each other, and means for moving the lights independently of each other.

957,713. CIRCUIT CLOSER OR TIMER. William J. Rapp, Detroit, Mich., assignor to H. H. Creighton and Alexander Arnold, Toledo, Ohio. Filed January 27, 1908. An electric ignition timer for explosion engines.

957,714. MAGNETO-ELECTRIC GENERATOR. Frank I. Remy and Benjamin P. Remy, Anderson, Ind., assignors to Remy Electric Company, Anderson, Ind. Filed March 25, 1909. A magneto-electric generator includes a case or frame, horseshoe magnets mounted in connection with the casing or frame, a strap extending over the tops of the magnets with the ends thereof extending downwardly, and means mounted in connec-

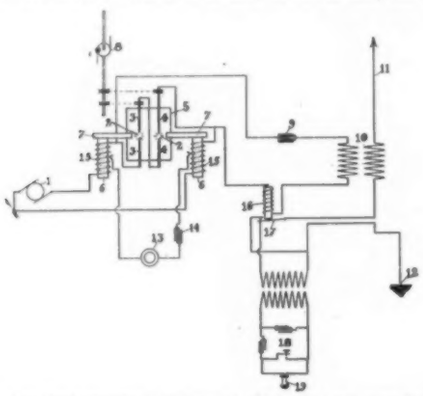
tion with the top of the frame of the casing with which the ends of the strap are connected for drawing and holding the strap down tightly in place.

957,719. ELECTRIC-LAMP SOCKET. Frank E. Seeley, Bridgeport, Conn., assignor to the Bryant Electric Company, Bridgeport, Conn. Filed December 15, 1908. A pull switch comprises an inclosing shell, a switch body therein, a chain guide independent of the shell, and readily accessible means for detachably securing the guide to the switch body within the shell.

957,776. VENTILATING-FAN. Robert A. Ilg, Chicago, Ill. Filed February 23, 1906. Comprises a fan-casing and a fan mounted therein, a motor for the fan, a shutter (mounted across the discharge end of the fan casing) with blares pivoted in a line substantially coincident with their upper edges whereby they normally tend to close by gravity or external wind pressure, a motor and connections therefrom to the shutter blades, and means for simultaneously energizing and de-energizing the motors.

957,785. ELECTRIC-HEATER FOR OIL-WELLS. Oscar B. Linquest, Jamestown, N. Y., assignor of one-half to Archibald F. Russell, Lakewood, N. Y. Filed June 29, 1909. An electric heater for oil wells comprises two or more insulating tubes, means for spacing these tubes apart from each other, a resistance wire wound around the tubes, means for conducting a current from any suitable source of energy through the resistance wire, and means for lowering and raising the tubes and wires in any desired position in an oil well.

957,792. ELECTRIC METER. Charles E. J. O'Keenan, St. Cloud, France. Filed June 28, 1909. A device for obtaining a fall of potential propertional to the watts absorbed in a continuous current circuit, comprises a shunt, a sub-shunt, and a winding



957,852.—TRANSMITTING SYSTEM FOR SPACE TELEPHONY.

(for heating the sub-shunt) the ends of which are connected to the main conductors of the installation.

957,706. REGULATING INCANDESCENT-LAMP SOCKET FOR REDUCING THE LIGHT. Edward H. Smith, Aberdeen, Wash., assignor of one-half to Thomas Evenson, Seattle, Wash. Filed December 7, 1909. A rotary rheostat ring is mounted within the socket casing, to co-operate within a number of independent coils of variable resistance.

957,824. ELECTRICALLY-HEATED ROLLER. George H. Wade, Atlanta, Ga. Filed August 11, 1909. A roller is provided with recesses formed in its opposite ends, electrical heating elements disposed within the recesses, and means connecting the heating elements forming a journal for the roller.

957,852. TRANSMITTING SYSTEM FOR SPACE TELEPHONY. Victor H. Laughter, Detroit, Mich. Filed July 10, 1909. Space telephony apparatus comprises a transmitting set including in the circuit oscillation-inducing means adapted to be adjusted to a state of inactivity close to the critical point, and means adapted when influenced by sound waves to bring the oscillation-inducing means to the critical operative point, a receiving set, and means in circuit with the transmitting set adapted to throw the receiving set into operative relation with the aerial limb of the transmitting set when the oscillation-inducing means is inactive and to cut out the receiving set when the inductor is rendered active.

REISSUE.

13,114. ELECTRIC SWITCH. Everett M. Coffin, Oakland, Cal. Filed January 17, 1910. Serial No. 538,562. Original No. 881,300, dated March 10, 1908. Reissue No. 12,841, dated August 11, 1908, Serial No. 440118. Comprises a contact, a shaft on which this contact rocks, a shifter also rocking on the shaft and operatively connected with the contact, a coiled spring around the shaft for energizing the shifter, and a controller having side members and a bridge connecting them, the opposite side members being pivoted on the shaft on opposite sides of the coiled spring.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired May 16, 1910:

497,310. AUTOMATIC DISCONNECTOR. William A. Cullen, Paterson, N. J.

497,324. PROCESS OF MAKING MICA INSULATING-PLATES. Charles W. Jefferson, Schenectady, N. Y.

497,331. AUTOMATIC TIME-STAMP. Warren B. Martindale, Rochester, Ind.

497,335. MANUFACTURER OF TELEPHONE-CABLES. William R. Patterson, Chicago, Ill.

497,336. INSULATING-TAPE. William R. Patternson, Chicago, Ill.

497,337. OVERHEAD ELECTRIC RAILWAY. William D. Patterson, Keokuk, Iowa.

497,356. ELECTRIC-CAR TRUCK. George S. Strong, New York, N. Y.

497,361. COMMUTOR BRUSH-HOLDER FOR DYNAMO-ELECTRIC MACHINES. Elihu Thomson, Swampscott, Mass.

497,366. RHEOSTAT. Parvin Wright, Denver, Colo.

497,377. TROLLEY FOR CONDUIT RAILWAYS. Paul C. Just, Chicago, Ill.

497,382. NON-CONDUCTING COVERING. Robert H. Martin, Brooklyn, N. Y.

497,385. APPARATUS FOR HEATING STREET-CARS. James F. McElroy, Albany, N. Y.

497,394. CONDUIT ELECTRIC RAILWAY. George Westinghouse, Jr., Pittsburg, Pa.

497,397. LIGHTNING ARRESTER. Alexander Wurts and Charles F. Scott, Pittsburg, Pa.

497,404. ELECTRIC CIGAR-LIGHTER. William P. Carstarphen, Jr., Denver, Colo.

497,408. ELECTRIC-RAILWAY SIGNAL. William H. Jordan, Brooklyn, N. Y.

497,411. PUSH-BUTTON SWITCH. Fred S. McGregory, Revere, Mass.

497,430. CIRCUIT-PROTECTOR. Harry W. Leland, Jersey City, N. J.

497,436. SECTIONAL CONTACT-CONDUCTOR FOR ELECTRIC RAILWAYS. George Westinghouse, Jr., Pittsburg, Pa.

497,438. ARC ELECTRIC LAMP. John C. Wray, Peoria, Ill.

497,448 and 497,449. GALVANOMETEIR. Adrian H. Hoyt, Manchester, N. H.

497,450. ELECTRIC-ARC LAMP. Rudolph M. Hunter, Philadelphia, Pa.

497,468. DYNAMO-ELECTRIC MACHINE OR MOTOR. Walter K. Freeman, Boston, Mass.

497,482. SHUNT FOR ELECTRIC LIGHT AND POWER STATIONS. Edward Weston, Newark, N. J.

497,489. CIRCUIT-CONTROLLING DEVICE. John P. Buchanan, Boston, Mass.

497,491. AUTOMATIC CUT-OUT FOR ELECTRIC LIGHT CIRCUITS. Charles Cuno, Wauwatosa, Wis.

497,494. ELECTRIC-ARC LAMP. James Einstein, Munich, Germany.

497,495. ELECTRIC RINK. Midbury W. Hassan, Rochester, N. Y.

497,504. ARMATURE-CORE FOR ELECTRIC MOTORS. James E. Stuart and Ulysses S. James, Helena, Mont.

497,507, 497,508 and 497,509. LIGHTNING-ARRESTERS. Alexander Wurts, Pittsburg, Pa.

497,515. INSULATOR. Thomas H. Brady, New Britain, Conn.

497,521. ELECTRIC MEASURING-INSTRUMENT. Adrian H. Hoyt, Manchester, N. H.

497,522. GALVANOMETER. Adrian H. Hoyt, Manchester, N. H.

497,535. PROCESS OF MANUFACTURING ELECTRIC-CONDUIT SECTIONS. James F. Cummings, Detroit, Mich.

497,536. UNDERGROUND CONDUIT FOR ELECTRICAL CONDUCTORS. James F. Cummings, Detroit, Mich.

497,539. ELECTRICAL MEASURING INSTRUMENT. Oscar Frolich, Berlin, Germany.

497,540. DEVICE FOR ILLUMINATING GUN-SIGHTS BY ELECTRICITY. Giovanni G. DiGiovanni, Turin, Italy.

497,552. SYSTEM OF CONDUCTORS FOR ELECTRIC FIRE ENGINES. Joseph Sachs, New York, N. Y.

497,558. ELECTRIC ARC LAMP. Frank H. Thompson, Philadelphia, Pa.

497,563. ELECTRIC PUMP-GOVERNOR. Charles R. Whittier, New York, N. Y.

497,585. CLOSED CONDUIT FOR ELECTRIC RAILWAYS. Archibald J. Martin, Philadelphia, Pa.

497,649. MAGNETO-TELEPHONE. James P. Freeman, Washington, D. C.

497,680. SAFETY CUT-OUT APPARATUS FOR NETWORKS OF MULTIPLE ELECTRICAL CONDUCTORS. Paul Nordmann, Berlin, Germany.

497,755. SYSTEM OF ELECTRICAL DISTRIBUTION. Waldemar Meissner, Konigsberg, Germany.

497,756. CIRCUIT SWITCH. Ernest Woltmann and Harry A. Triggs, Denver, Colo.